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"SATELLITE STUDY, TROPICAL NORTH ATLANTIC, 1963"

PART II

Satellite and Conventional Data
A Daily Comparison, October 1-November 9

by

C.I. Aspliden

G.A. Dean

H. Landers

Department of Meteorology

Florida State University

Report No.67-11

Prepared under Grant No. WBG 58

ESSA

National Environmental Satellite Center

Meteorological Satellite Laboratory

December 1967

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Foreword

This is the sixth of a series of reports, all of which will have the same main title but different subtitles. There are three parts, the first two of which are subdivided into three periods:

Part I. Surface Wind Analysis

July 26 - August 31 (issued September 1965)

September 1 - September 30 (issued March 1966)

October 1 - November 10 (issued October 1966)

Part II. Satellite and Conventional Data; A Daily Comparison

August 1 - August 31 (issued July 1966)

September 1 - September 30 (issued May 1967)

October 1 - November 9

Part III. Special Topics.

The above reports will not necessarily be issued in the order listed.

H. Landers

Principal Investigator

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Acknowledgements

The research program has been sponsored by the Meteorological Satellite Laboratory, N.E.S.C., ESSA under Grants WBG 32 and WBG 58. The authors also wish to thank the many students in the Department of Meteorology, Florida State University, who carried out the detailed work necessary for the production of the maps and charts in this report; particularly Henry Cooper, Caroline Dean, Lance Hancock, William Hannon and Jack Wallace. Data were supplied by Marine Meteorological Offices in England, France, Germany and the Netherlands, as well as from several domestic sources within ESSA. The manuscript was typed by Janina Richards.

We shall draw freely on the results of the extensive analysis of the IGY period in 1958, which has been accomplished by G. A. Dean under the direction of Prof. N. E. LaSeur and sponsored by the National Hurricane Research Laboratories, I.E.R., ESSA.

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We shall draw freely on the results of the extensive analysis of the IGY period in 1958, which has been accomplished by O. A. Dean under the direction of Prof. K. E. Ledeen and sponsored by the National Aeronautics Research Laboratories, I.E.R., ESSA.

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10. October, 1963 mean surface wind and pressure map (knots and mb).

The illustrations appear at the end of the section to which they pertain and are not numbered as pages.

The maps and charts which form the basis of this report appear at the end in chronological order and have been assigned neither figure numbers nor page numbers.

REFERENCES

1. Aspliden, C. I., G. A. Dean, and H. Landers: Satellite Study, Tropical North Atlantic, 1963. Part I, Surface Wind Analyses, July 26 - August 31, September 1-30, October 1 - November 10. Reports to Met. Sat. Lab., N.E.S.C., ESSA, Grant Nos. WBG 32 and 58, September 1965, March 1966, October 1966.
2. Climatological Data, National Summary, Annual 1963, Vol. 14, No. 13, U.S. Weather Bureau.
3. Aspliden, C. I., G. A. Dean, and H. Landers: Satellite Study, Tropical North Atlantic, 1963. Part II, Satellite and Conventional Data, A Daily Comparison, August 1-31, September 1-30, Reports to Met. Sat. Lab., N.E.S.C., ESSA, Grant No. WBG 58, July 1966 and May 1967.

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1. Cyclone (dashed) and anticyclone (dotted) tracks at 200 mb., October, 1963.

2. Cyclone and anticyclone tracks at 200 mb, 1-8 October, 1963.

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REFERENCES

1. Aspliden, C. I., O. A. Dean, and R. Lauderer: Satellite Study, Tropical North Atlantic, 1963. Part I, Surface Wind Analyses, July 26 - August 31, September 1-30, October 1 - November 10. Reports to Met. Sat. Lab., E.S.S.A., NESA, Grant Nos. WBG 32 and 50, September 1965, March 1966, October 1966.

2. Climatological Data, National Summary, Annual 1963, Vol. 15, No. 13, U.S. Weather Bureau.

3. Aspliden, C. I., O. A. Dean, and R. Lauderer: Satellite Study, Tropical North Atlantic, 1963. Part II, Satellite and Conventional Data, & Daily Comparisons, August 1-31, September 1-30, Reports to Met. Sat. Lab., E.S.S.A., NESA, Grant No. WBG 32, July 1966 and May 1967.

PURPOSE

The conventional analyses were completed in the final form shown in the published reports for Part I and Part II (see Foreword, page ii) without reference to the satellite pictorial and radiation data. The final analyses were then compared with picture mosaics and nephanalyses of all of the satellite passes (TIROS VI and VII) available for the region. There was an average of four and one-half passes per day in August, four passes per day in September and about two in October and in early November. In general, there was good agreement between the conventional analyses and satellite pictures. Some of the places of apparent disagreement will be dealt with in Part III of this series of reports.

One of the main objectives of the project is to compare satellite pictorial information and analyses of satellite radiation data with two or three levels of analyses of conventional data in order to determine how they can complement each other.

1. Introduction

Part I [1] of this series of reports presented twelve-hour continuity at sea-level for the intertropical Atlantic region for August, September, October and early November, 1963. Part II presents twenty-four hour continuity at sea-level and at 200 mb plus cloud charts and mosaic presentation of satellite pictures for a considerably larger area which includes the region depicted in Part I.

Due to the size and the thickness of the Part II reports, as well as difficulties in presentation, it was decided that the text should be kept as brief as possible. The maps and charts are presented in a catalog form and no daily comments concerning intercomparisons of the charts are included. The viewer is invited to make his own comparisons.

Specific areas, periods and phenomena will be studied in considerable detail and the results will be presented in Part III (Special Topics) in this series of reports.

2. The surface maps

The streamline analyses in the region 15°-60°W, 5°S-25°N are the same as those shown in [1]. These analyses have been extended westward to 90°W longitude. African data have been added to the east of the area of the earlier analyses [1] but the paucity of data does not permit reliable analysis in that region.

The sea-level pressure field has been analyzed from 25°-46°N. The frontal positions shown were taken from the Weather Bureau's hemispheric charts which are analyzed on a current basis in the NMC in Washington, D. C. Our original pressure analyses employed a two-millibar interval, but a

four-millibar interval is used in this report.

Initial plans did not call for extending the analyses north of 35°N. However, a further northward extension seemed necessary to establish vertical continuity on the Atlantic upper-level trough and its associated cyclones. In this connection, daily 500 mb analyses were also prepared but these are not presented due to space considerations and because the analyses are extremely tenuous south of 20°N in the Central Atlantic. Almost no aircraft data are present at levels near the 500 mb pressure surface.

There were several reasons for preferring an isobaric analysis north of 25°N. There is no scarcity of ship reports, geostrophic control is much more firm and a delineation of sub-synoptic or mesoscale systems was not necessary.

Surface and 2000 ft winds at coastal and island stations were used in preparing the pressure analyses but are not reproduced on the maps. Very frequently these data are the least representative to be found in regions which are mainly oceanic in nature. The maps shown herein, then, are essentially derived from ship reports. However, some land station reports have been plotted in southwestern Europe. The principal function of these and the African reports will be to provide conventional cloud information to correlate with the satellite data.

Positions of tropical depressions, storms and hurricanes north of 25°N have been taken from the track data supplied by the National Hurricane Center in Miami [2].

Although individual ships were not tracked in detail as in [1], all suspect pressure values were double-checked for position and transcription errors. As previously stated, a sufficient number of reports was available even after suspect values were eliminated.

3. Upper Air Analysis

The 200 mb surface was selected for the upper level analysis because it is representative of the high tropospheric tropical regime and aircraft data are present at high levels. As mentioned earlier, 500 mb analyses were performed also but are not presented here. A streamline analysis was considered preferable at 200 mb. A meaningful contour analysis cannot be performed due to the presence of large height errors at the 200 mb level and the small height gradients which normally exist, and below 15°N latitude the geostrophic and gradient wind concepts do not hold. Scarcity of reports also favors a streamline analysis.

Additional rawinsonde data problems are: the use of different types of instruments; the fact that all of the countries involved do not all take observations at the same time and the occurrence of systematic errors in the reports from some stations; for example, Funchal at 33°N, 17°W has temperatures and heights which are always too low. Offtime reports were plotted and used with suitable adjustments when ontime reports were absent. Some pilot balloon ascents reached the 200 mb surface and all such reports are plotted on the maps.

Analyses at 200 mb were performed also at 0000 GMT for the northern and western part of the area shown on the 1200 GMT charts to help establish and maintain continuity on upper-level systems.

Most of the jet aircraft flights between Europe and the Caribbean-S. American area provide Doppler radar wind observations as well as temperature, flight level and an occasional remark about cumulonimbus cloud activity. The observations lie between 31,000 and 39,000 feet above MSL with an average height of 35,000 feet. This average is very close to the 250 mb surface and this surface rather than 200 mb would have been selected for the high level

analyses except for the fact that no European nor African radiosonde stations report at 250 mb. The aircraft observations are generally taken at points five degrees of longitude apart (about 3/4 of an hour of flight time). A given flight may begin at 33,000 ft, rise to 35,000 ft in the mid-Atlantic and rise again to 37,000 ft near the end of its route. All of the aircraft data have been plotted on the 1200 GMT maps; that is, data from 0000 GMT to 2359 GMT for any given day. However, only the observations from 0600 GMT to 1759 GMT were used in the 1200 GMT analyses. The reader is urged to check the observation time as well as our track charts for plotted winds which do not seem to fit the streamline analyses. All observations, ± 6 hours, were adjusted for time and fit out continuity of synoptic systems. For the most part, it was assumed that little or no vertical changes in structure and position of synoptic systems occur in the 200-300 mb layer in the central Atlantic region. Some evidence to support this was presented in [3, fig. 12]. Also shown in [3, fig. 1] is an example of the way in which offtime aircraft reports were used.

Twenty-four hour past history is shown on the 200 mb charts for the cyclones (dashed lines) and anticyclones (dotted lines) and the present and previous positions are indicated with an x. Initial and final stages of cyclones and anticyclones are represented by cusps. The surface positions of hurricanes and tropical storms have been entered on the 200 mb charts, also the last day of the depression stage for intensifying storms and the first day of the depression stage for weakening storms. The tropical cyclone name and its stage D, S or H have also been entered. All of the above positions and classifications are from [2] north of 25°N latitude. South of that latitude the positions may be slightly different due to a better data sample than was available for the Weather Bureau publication [2].

FLORA

⊢ VORTEX TERMINATED

Fig. 1. Cyclone (dashed) and anticyclone (dotted) tracks at 200 mb, October, 1963.

FLORA

X 0000 Z POSITION

O 1200 Z POSITION

⊢ VORTEX TERMINATED

Fig. 2. Cyclone and anticyclone tracks at 200 mb, 1-6 October, 1963.

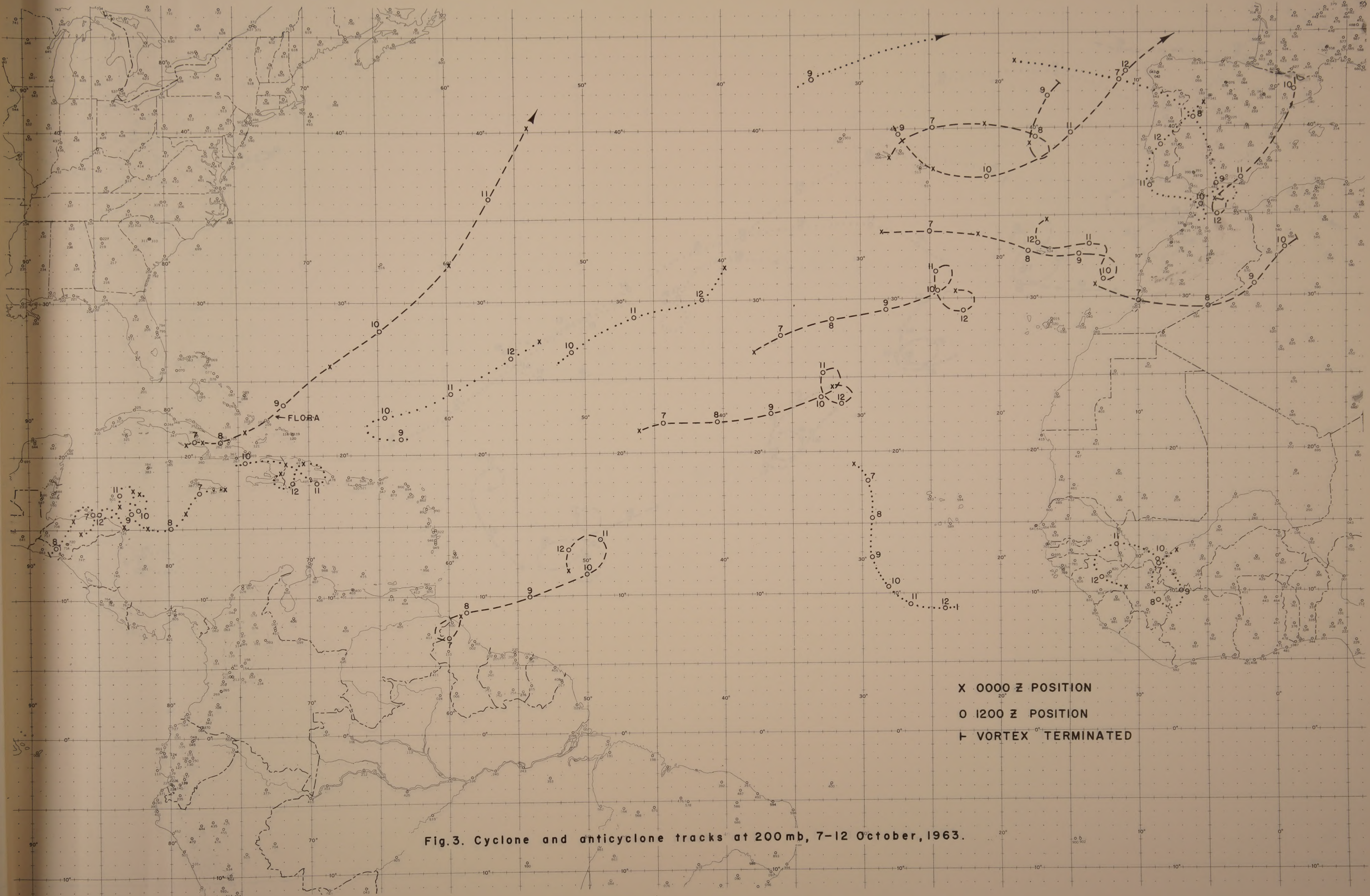


Fig. 3. Cyclone and anticyclone tracks at 200 mb, 7–12 October, 1963.

X 0000 Z POSITION

O 1200 Z POSITION

⊢ VORTEX TERMINATED

Fig. 4. Cyclone and anticyclone tracks at 200 mb, 13–18 October, 1963.

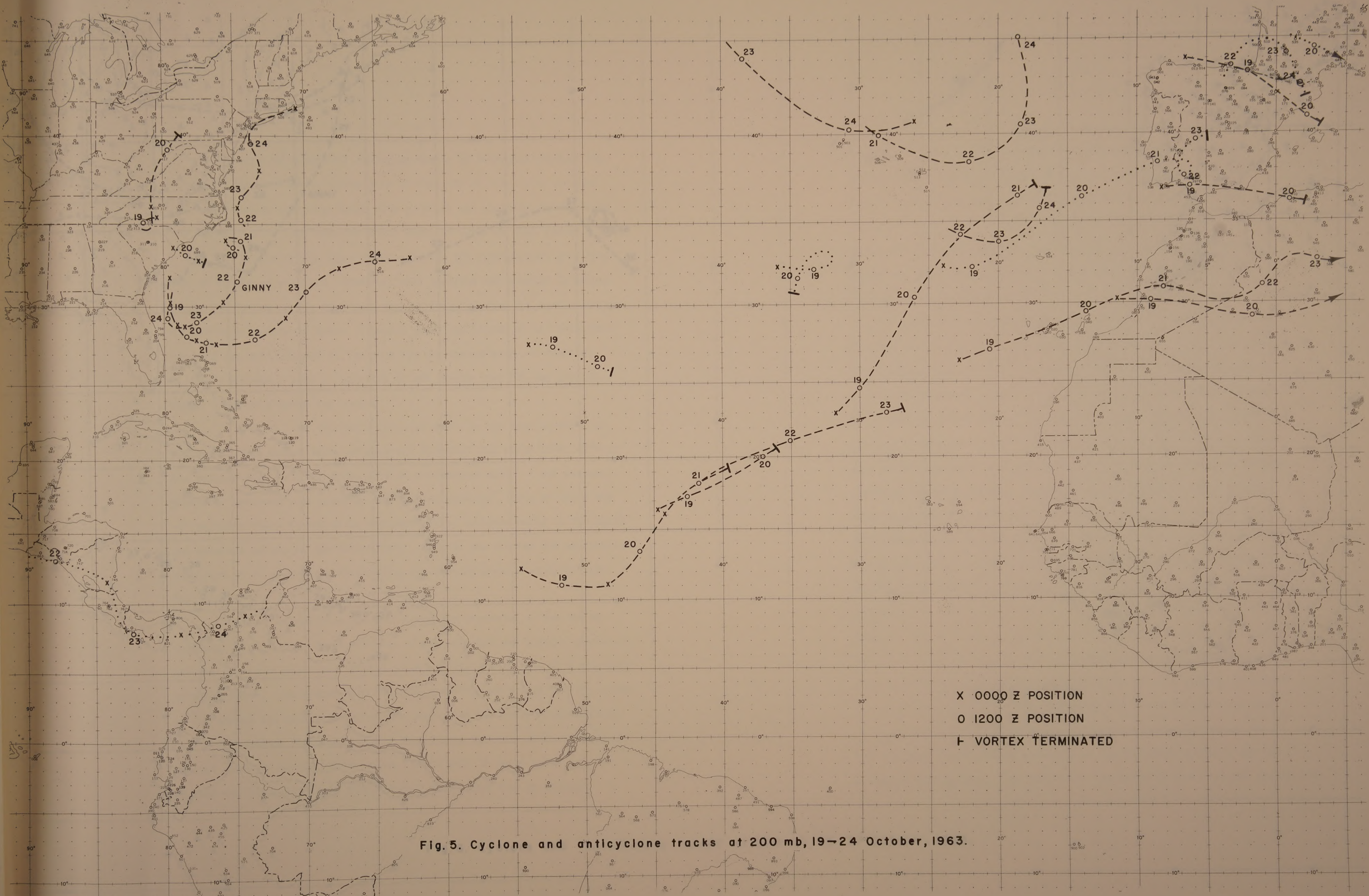


Fig. 5. Cyclone and anticyclone tracks at 200 mb, 19–24 October, 1963.

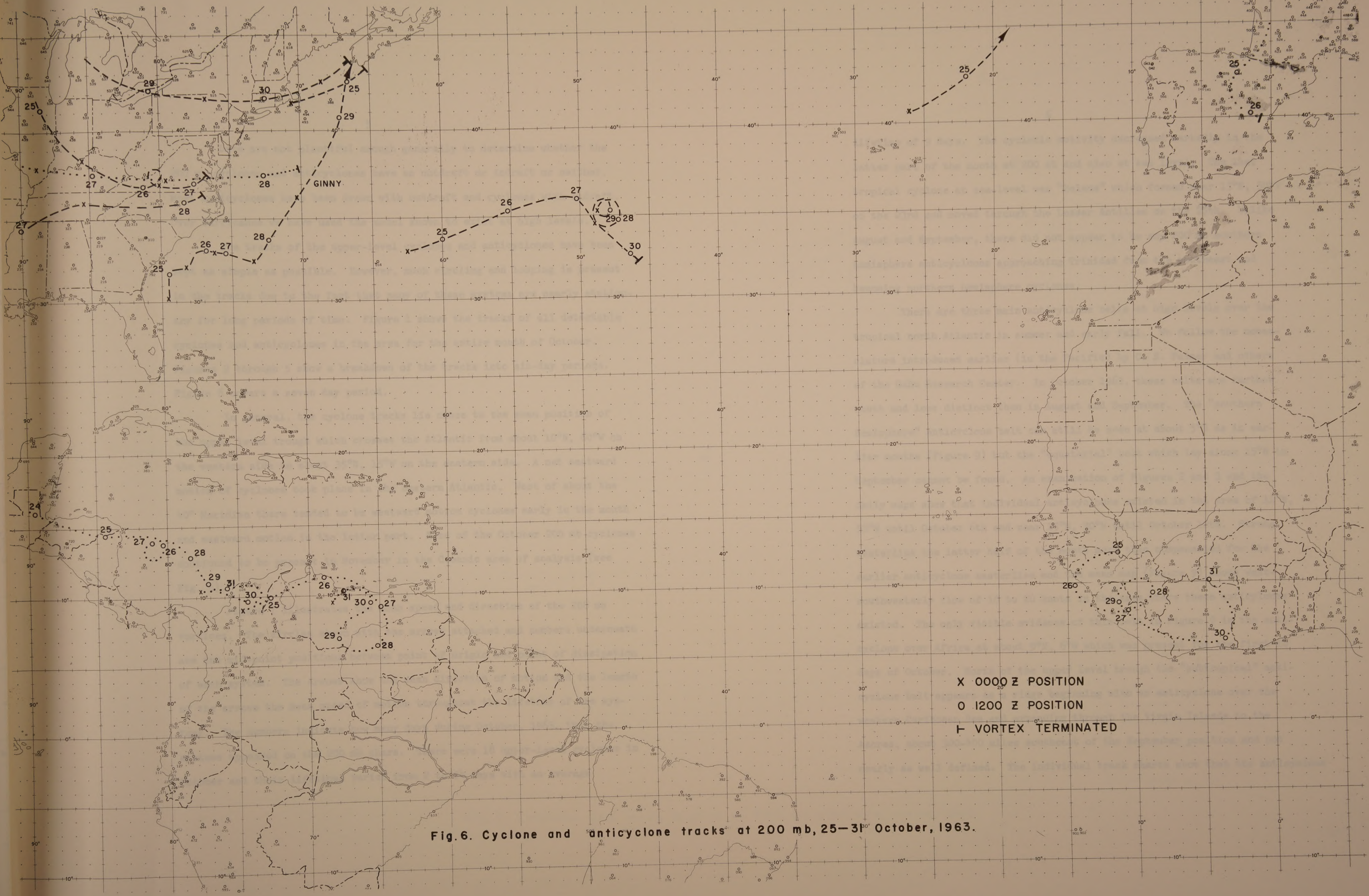


Fig. 6. Cyclone and anticyclone tracks at 200 mb, 25–31 October, 1963.

Data are not plentiful enough generally to determine whether the 200 mb cyclones and anticyclones have an outdraft or indraft or neither. Most anticyclones have been drawn with outdraft and cyclones with indraft. Over hurricanes we have used the model known to exist at high levels.

The tracks of the upper-level cyclones and anticyclones have been kept as simple as possible. However, much circling and looping is present in the tracks due to the fact that many of these systems are nearly stationary for long periods of time. Figure 1 shows the tracks of all detectable cyclones and anticyclones in the area for the entire month of October. Figures 2 through 5 show a breakdown of the tracks into six-day periods. Figure 6 covers a seven day period.

In general, the cyclone tracks lie close to the mean position of the upper level trough which crosses the Atlantic from about 10°N, 60°W on the western side to about 35°N, 15°W on the eastern side. A net eastward motion of cyclones took place in the eastern Atlantic. West of about the 40° Meridian there tended to be westward motion cyclones early in the month and eastward motion in the latter part. None of the October 200 mb cyclones continued to be present in November in the Oceanic area of analysis (see Fig. 6).

Figure 7 illustrates the mean speed and direction of the 200 mb vortices. The circles shown with the arrows attached and numbers underneath are the mid-point positions between point of origin and point of dissipation of each system. The arrows show the mean direction of motion and the length of the arrows the mean speed of motion throughout the lifetime of the systems. The numbers indicate how many days during October, 1963, that the systems appeared on the 200 mb chars. There were 18 upper-level cyclones in October and their lifetimes varied from 2 to 24 days with an average

lifetime of 9 days. The cyclonic activity decreased markedly in the latter part of the month at 200 mb and also at sea level. The last tropical cyclone at sea-level was "Helena" which formed near 13°N, 50°W on the 23rd and moved through the Lesser Antilles on the 25th. Unlike August and September, there did not appear to be any 200 mb southern hemisphere anticyclones approaching Trinidad from the southeast and becoming northern hemisphere cyclones.

There are three main anticyclone belts at high levels over the tropical north Atlantic in summer and early fall. We follow the nomenclature introduced earlier (in the Pacific) by C. E. Palmer and others of the Oahu Research Center. In October 1963, these belts are farther south and less distinct than in August and September. The "southern hemisphere" anticyclone belt can still be seen at about 5°S as in earlier months (Figure 9) but the "equatorial" belt which lay along 15°N in September cannot be found. An examination of Figures 2 and 3 and the daily maps show that individual anticyclones existed in the area of 12°N, 50°W until October 6th and near 15°N, 30°W until October 12th. Strong westerlies the latter half of the month more than compensated for the earlier anticyclone easterlies and the mean map (Figure 9) shows west-southwesterly flow of 10 to 20 knots in the area where these anticylones existed. The only visible evidence of this belt in Figure 9 is the anticyclone over Africa at about 9°N, 6°W which was present for the first 18 days of October. North of the upper level trough the "subtropical" anticyclone belt appears as a ridge beginning with an anticyclone over the western Caribbean Sea and extending through the Virgin Islands to the Azores, about 300-400 miles southeast of the September position and not nearly as well defimed. The individual track charts show that the anticyclone

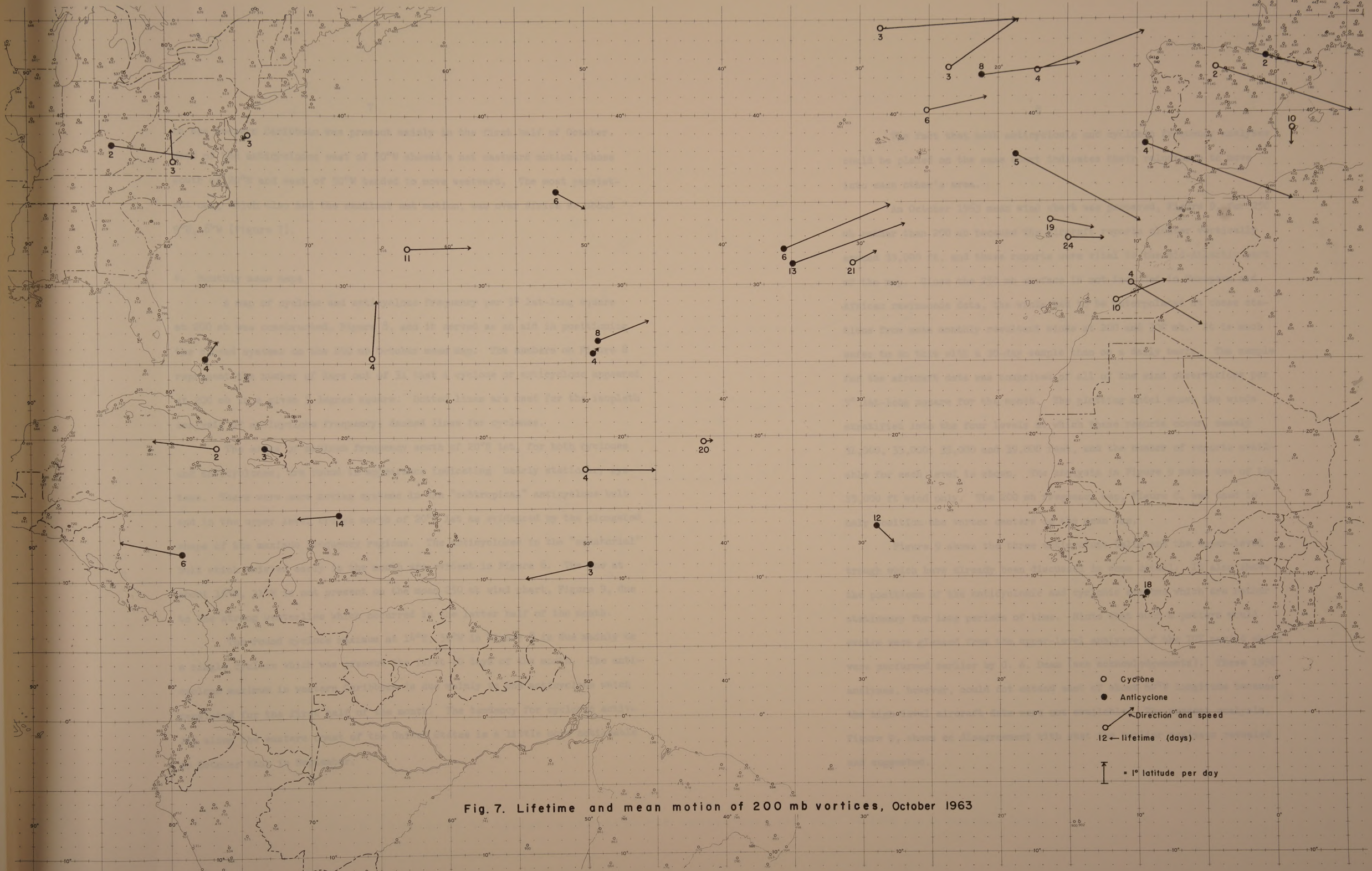


Fig. 7. Lifetime and mean motion of 200 mb vortices, October 1963

in the western Caribbean was present mainly in the first half of October. Most of the anticyclones east of 50°W showed a net eastward motion, those south of 20°N and west of 50°W tended to move westward. The most persistent one, which also had the smallest net motion, was over Africa at about 9°N, 6°W (Figure 7).

4. Monthly mean maps

A map of cyclone and anticyclone frequency per 5° lat-long square at 200 mb was constructed, Figure 8, and it served as an aid in positioning the closed systems on the 250 mb October mean map. The numbers on Figure 8 represent the number of days out of 31 that a cyclone or anticyclone appeared at 200 mb in a given 5 degree square. Dotted lines are used for the isopleth analysis of anticyclone frequency, dashed lines for cyclones.

The areas of maximum frequency south of 20°N lat, for both cyclones and anticyclones, are round in appearance indicating nearly stationary systems. There were more moving systems in the "subtropical" anticyclone belt and in the upper level trough north of 20°N lat as evidenced by the alongated shape of the maximum frequency regions. The anticyclones in the "equatorial" belt which existed early in the month are evident in Figure 8. The one at about 16°N, 31°W is not present on the mean 250 mb wind chart, Figure 9, due to the strong westerlies which occurred in the latter half of the month.

The round cyclone maximum at 14°N, 51°W in Figure 8 is due mainly to a single cyclone which was present the first 20 days of the month. The anticyclone maximum in western Caribbean is due mainly to one anticyclone which persisted for the first half of the month. The tendency for cyclonic activity along the eastern coast of the United States is a little more noticeable in October than in September.

The fact that both anticyclonic and cyclonic frequency analyses could be placed on the same chart indicates their reluctance to move into each other's area.

An October 1963 mean wind chart was prepared, Figure 9, for 250 mb rather than 200 mb because the aircraft reports cluster vertically around 35,000 ft, and these reports were vital to the mid-Atlantic part of the map. Since the 250 mb surface is not included in European and African rawinsonde data, the winds had to be interpolated at these stations from mean monthly resultant winds at 200 and 300 mb. It is much safer to do this with a 30-day sample than on a daily basis. The sample for the aircraft data was comprised of all of the wind observations per 5° lat-long square for the month. The plotting model shows the winds stratified into the four levels at which these reports occur, namely 31,000, 33,000, 35,000 and 39,000 feet, and the number of reports available for each level is shown. The analysis in Figure 9 makes use of the 35,000 ft wind only. The 200 mb frequency map, Figure 8, was used to help position the vortex centers on the mean map.

Figure 9 shows the three anticyclone belts and the upper-level trough which have already been discussed in some detail. It also shows the positions of the anticyclonic and cyclonic systems which are rather stationary for long periods of time. Hints that such a pattern would evolve were gleaned from the upper-level analyses of the IGY period which were performed earlier by G. A. Dean (see acknowledgements). These 1958 analyses, however, could not extend east of about 60°W longitude because the high-level aircraft data were not available. The present analysis, Figure 9, shows no disagreement with what the earlier analyses revealed and suggested.

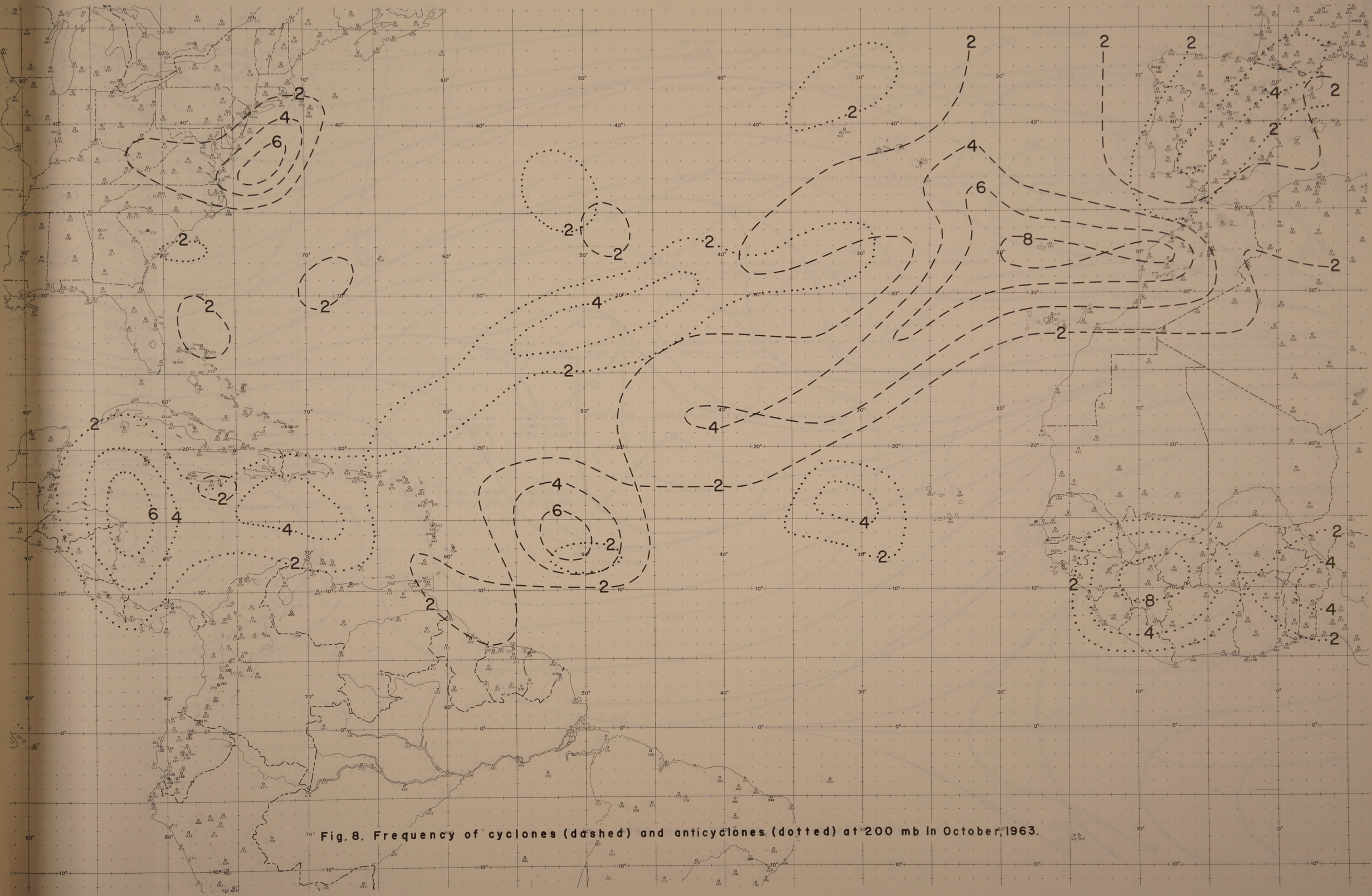


Fig. 8. Frequency of cyclones (dashed) and anticyclones (dotted) at 200 mb in October, 1963.

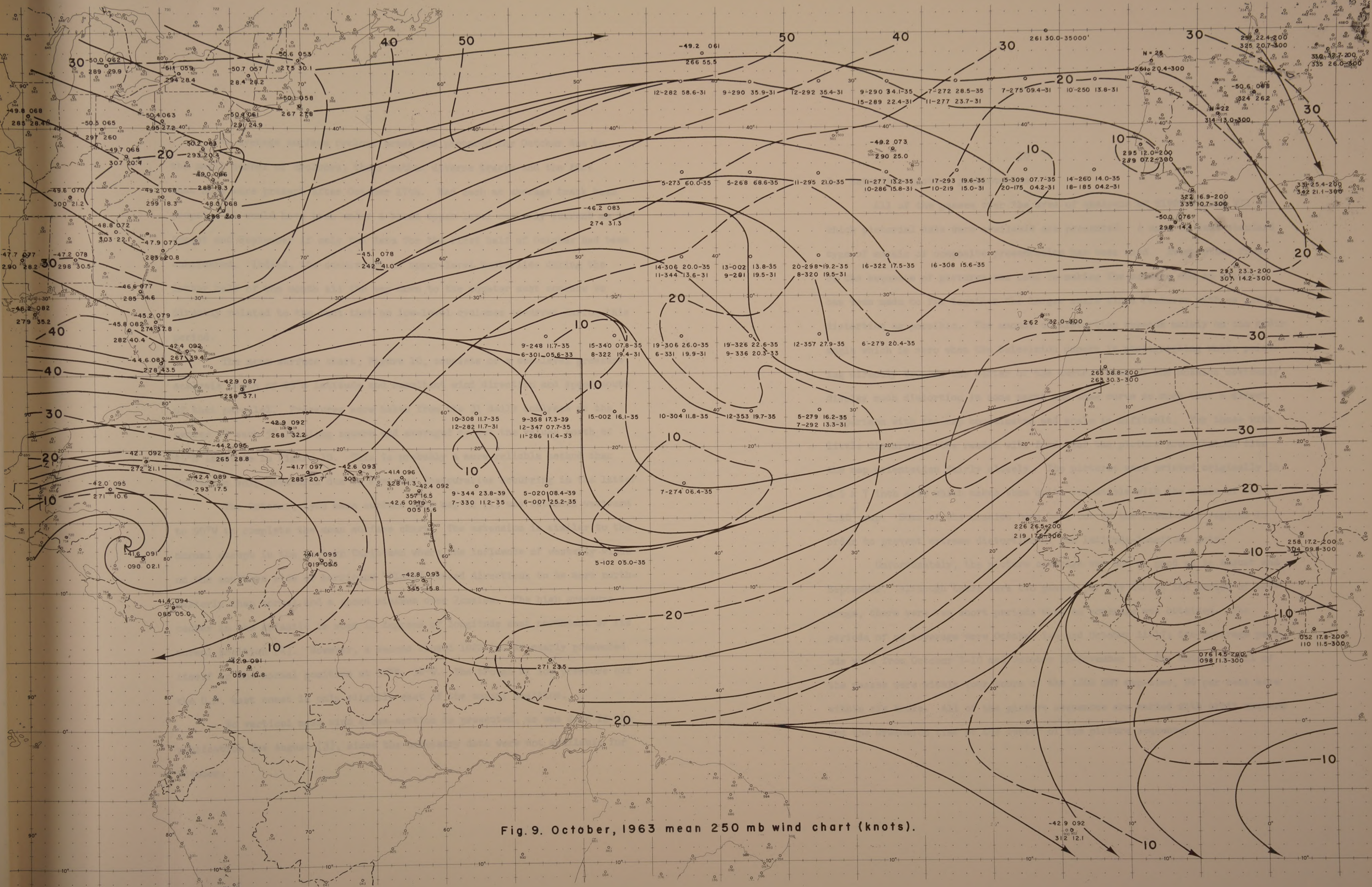


Fig. 9. October, 1963 mean 250 mb wind chart (knots).

No average surface cyclone track was prepared for October due to the small number of cyclones, their rather diverse tracks and the fact that none were present after October 17th. Had such an average track been prepared it would have been under a broad upper-level easterly current as in August and September if only the data for the first half of October had been considered. Indeed, the occurrence of upper-level westerlies during the latter half of the month all the way down to the equator must somehow be directly related to the fact that no low-level cyclones occurred during this period.

The mean surface chart, Figure 10, consists of a sea-level pressure analysis north of 25°N latitude and resultant wind direction and speed south of that parallel. Pressures were taken from the 31 daily analyses at the center of each 5° lat-long square and averaged to get the values north of 25°N latitude in Figure 10. This is probably a more reliable method than averaging ship pressures due to frequent inaccuracies occurring in the latter.

The October, 1963 mean surface wind map in [1] was extended westward to 90°W to complete the mean surface chart. The extension is similar to the normal except in the western Caribbean where the influence of westerly winds on the southern side of hurricane "Flora" caused directions to be more northeasterly than normal and a speed minimum over Jamaica. The high pressure center in the Atlantic is some 13 degrees of longitude east northeast of its normal position [4]. However, a second closed 1022 isobar nearly presented itself in the normal position at 32°N, 34°W. The trough of low pressure off the U.S. east coast is only slightly east of the normal position.

No vertical mean wind cross-section is presented, as was done in the publication for August [3], since the necessary data were not available for October.

5. Satellite picture presentation

All of the passes over the area of analysis of TIROS VI and VII for which pictorial data were available are presented. A more or less standard type of mosaic or composite presentation has been used. Every other frame of the sequence of pictures was used in making the mosaics and an attempt has been made to fit together the larger scale cloud features with as little distortion as possible. The amount of distortion depends mainly on the nadir angle which is zero when the television camera is photographing while pointing directly towards the center of the earth. Some of the mosaics obviously display much distortion in some parts and some curve so much that a direct comparison with the map coordinates and scale is difficult. For those with little distortion, the reader will find that the picture presentation fits the map orientation fairly closely. The pictures were printed originally in a 5 x 7 inch size which makes them quite compatible with the scale of the $1:10^7$ map. Some of the mosaics have been cut in the cloud-free regions in order to prevent extreme distortion of the latitude-longitude grid.

Unfortunately, the picture coverage was not as good as in August and September. Although there were two passes per day during the period of coverage, there were two short periods when no coverage was obtained. The periods of no coverage were October 1-6 and October 11-17; the coverage periods were from October 7-10 and October 18-November 8. Two thirds of all of the passes were within four hours of the 1200 GMT map-time, 96 per cent were within six hours. All of the picture sequences are marked with orbit numbers and the Greenwich time of the center of the picture sequence.

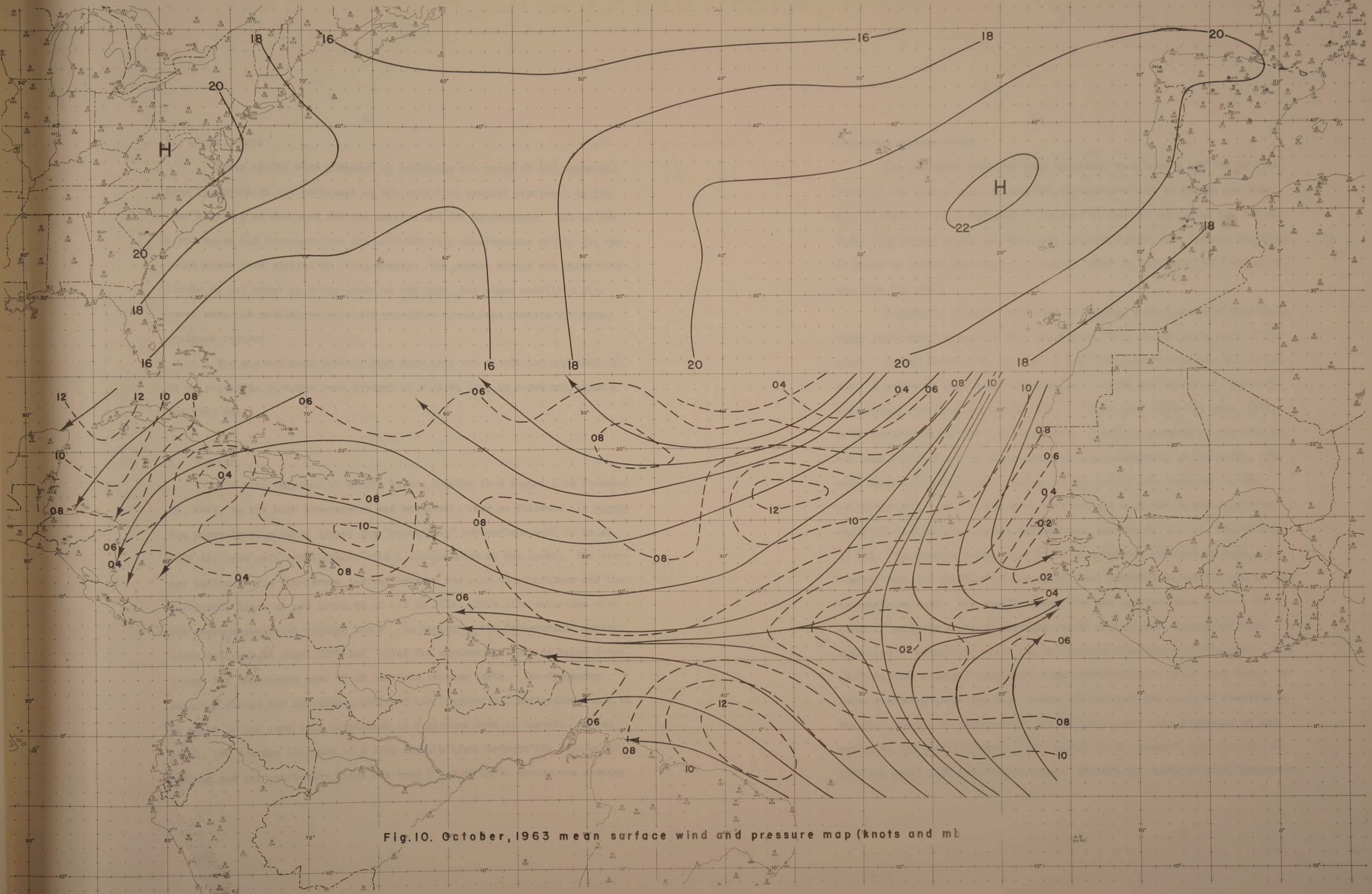
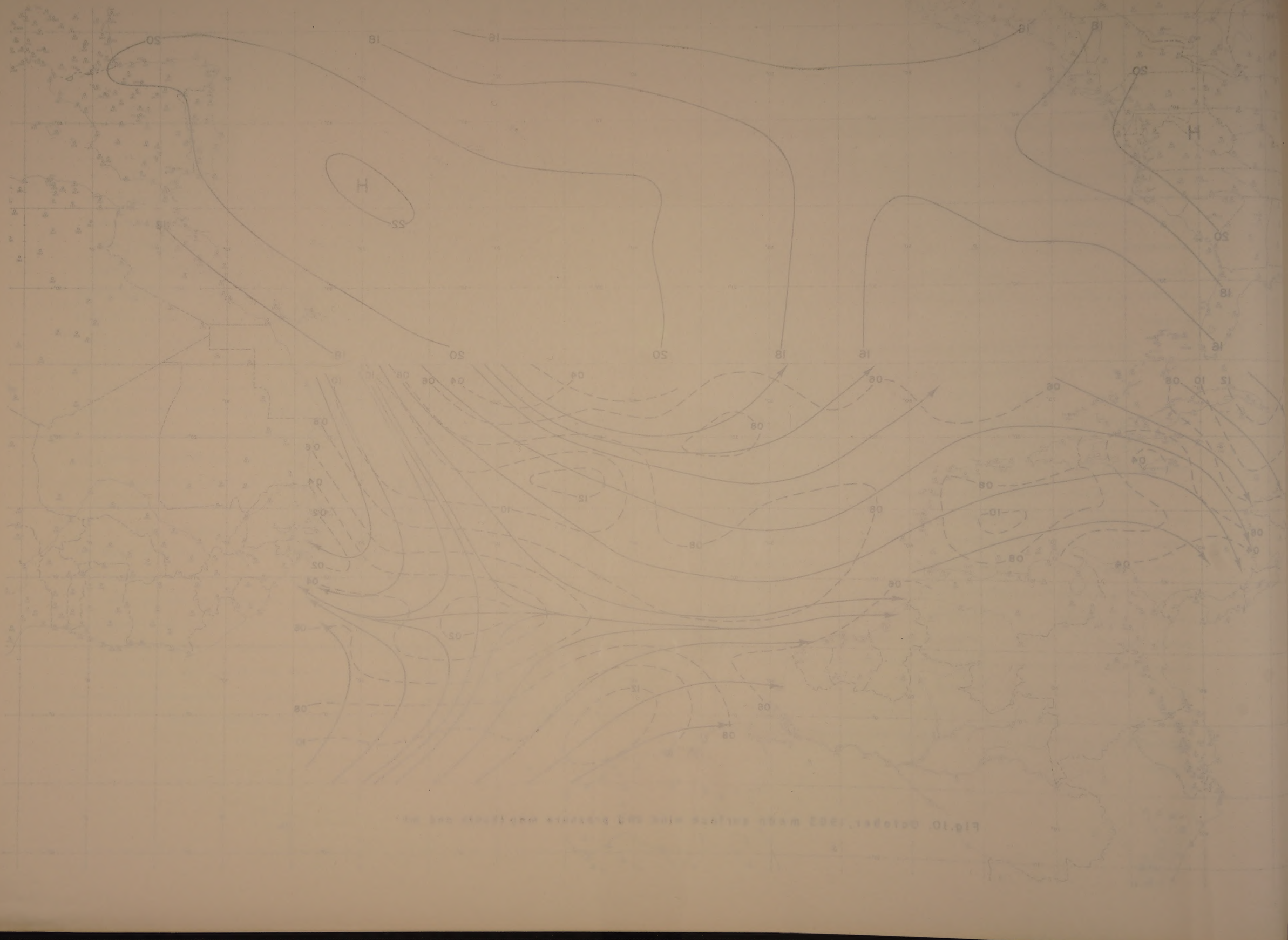


Fig. 10. October, 1963 mean surface wind and pressure map (knots and mb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6. Cloud charts

These charts were prepared by outlining the areas of the nephanalyses (prepared by the personnel at the satellite readout stations) on the same base map as was used for the surface and 200 mb analyses. All of the cloud types and coverage from the 1200 GMT ship observations within the outlined areas were plotted on these charts. The reader should not infer that clouds do not exist in other areas on the maps, but since satellite pictures were not present we have not presented cloud data outside the nephanalyses regions.

The conventional symbols have been used for clouds and sky coverage. If no satellite pictures were present on a given day, no cloud map appears for that day.

7. Summary

The time sequence of events in the tropics from August 1 to November 10, 1963, in the high troposphere and sea-level, were as follows: In August the upper-level picture showed the "equatorial" anticyclone belt to be at 20°N lat. and well established, with a trough lying to the north. The average latitude of a line drawn halfway between the wind-speed minimum and the confluence lines at sea level is 10 1/2 to 11°N. This line coincides with the average sea-level cyclone track. In September the "equatorial" anticyclone belt was at about 16°N lat. while the western part of the upper-level trough had also moved some 4° of latitude farther south. The frequency analyses showed the individual cells of the "equatorial" anticyclone belt to be about 30 per cent less persistent in September than in August. At sea level, the average latitude of a line drawn halfway between the wind-speed minimum and the confluence lines was bout 9 1/2 to 10°N, as was the average

sea-level cyclone track.

The low-level features just mentioned were some 9 1/2° of latitude south of the axis of the upper-level anticyclone belt in August and some 6 1/2° south of it in September. As near as one can determine the 250 mb level wind speeds above the low-level cyclone tracks, the figures are about 20 knots in August and between 10 and 15 knots in September, and the winds are from the east.

Figures 2, 3 and 4, show that in October there were four individual upper-level anticyclones in the "equatorial" belt in the early part of the month. One at about 11°N, between 45 and 55°W existed from the 3rd to the 6th. A second at an average latitude of 14 1/2°N and between 25 and 35°W was present from the 1st to the 12th. A third over Africa at about 10°N, 10°W lasted from the 1st until the 18th. A fourth appeared on the 25th in the same position as the third and lasted the remainder of the month. The only important oceanic anticyclone was the second one, present for the period October 1-12. There were six low-level cyclones in the equatorial trough in the Atlantic during this period, numbers 28, 29, 30, 31, 32 and 33 [1]. The average latitude of these cyclones was obtained by days, subtracted from the latitude of the upper-level anticyclone and the twelve differences averaged. The result showed that the cyclones were about 4 degrees of latitude south of the upper-level anticyclone, underneath weak upper-level easterlies, until the anticyclone disappeared on the 12th. The cyclones that remained were under weak southwesterlies after that date. Of those remaining after the 12th, number 32 weakened and lost its identity on the 14th, number 33 lasted until the 17th but moved only 9 degrees of longitude in the period October 12-17, number 34 was present from the 13th to 16th but never left the African coast. Cyclone 35, named tropical depression

Helena, appeared on October 23rd at about 50°W under the weak westerlies in the upper-level trough. It never developed into a tropical storm but moved westward to about 64°W lon. on the 26th to the west side of the upper-level trough where strong northwesterly winds aloft sent it back east to 60°W where it dissipated.

This brief survey shows that as time progressed from mid-summer to mid-autumn the upper-level equatorial anticyclone belt moved southward and weakened, finally disappearing entirely from the 200 mb charts. During the same period the low-level cyclones in the equatorial trough became less frequent and fewer developed into named storms. No cyclones (except for Helena) formed after October 13th and no cyclones remained after the 17th. The last upper-level anticyclone lost its identity on October 12.

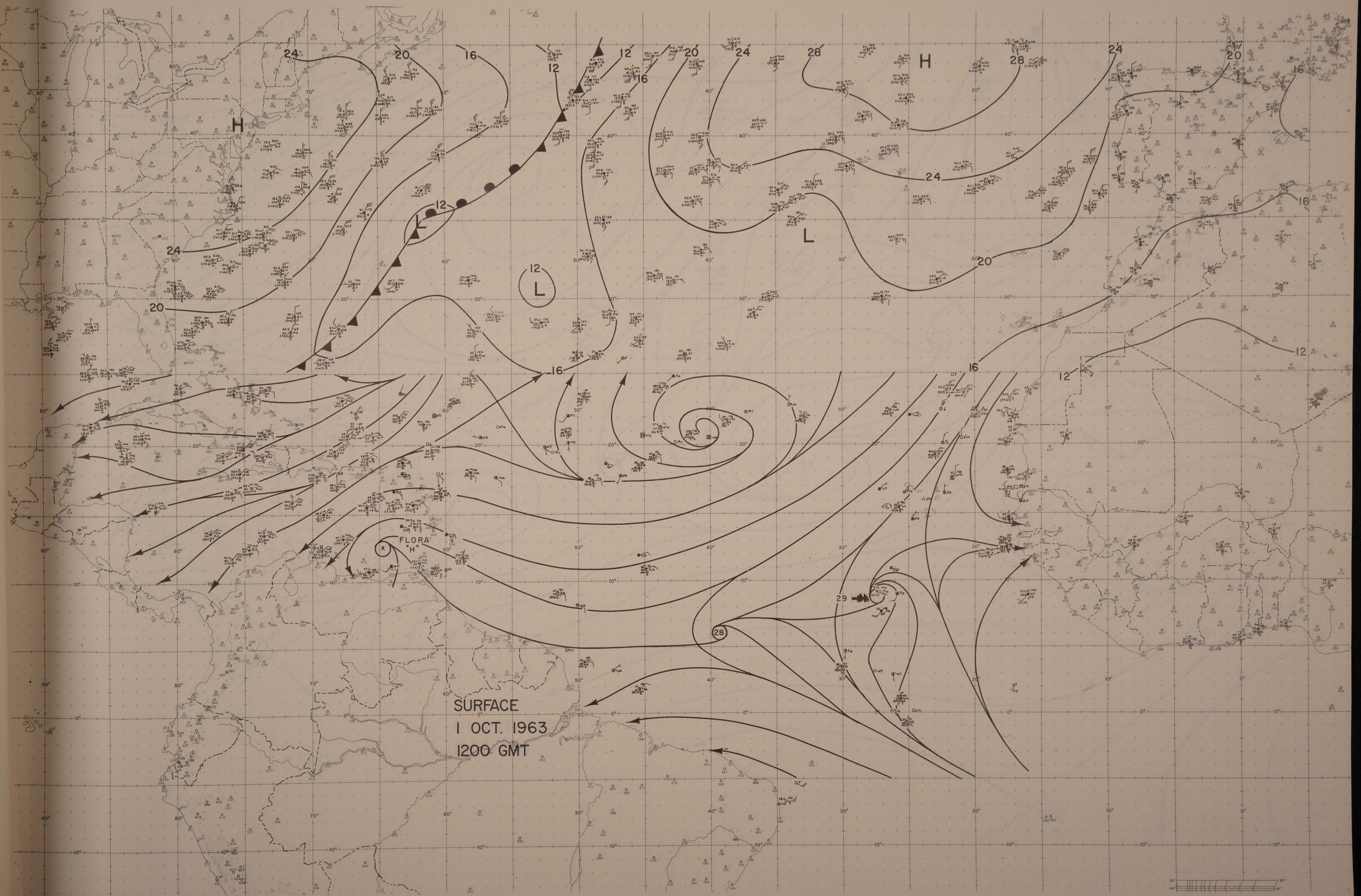
The mean position of the low-level cyclone track moved southward very little during the three-month period, so that the easterlies above the cyclones became weaker with time and finally changed to westerlies.

These findings are in accord with existing knowledge of tropical cyclone behavior; namely, that deep easterlies favor development of the cyclones and vice versa. However, this is the first time such events have been documented in the tropical Atlantic ocean region.

8. Catalog presentation of maps and charts

Two or more charts are presented for each day of the forty-day period. The surface chart is first and the 200 mb chart last on each day. On the days October 1-6 and 11-17 these are the only charts that appear. On all other days the satellite picture mosaic presentation is placed second, the cloud chart third and the 200 mb chart fourth. On some days two pages of satellite pictures are present.

There is no way to comment <u>briefly</u> on the relationships between satellite and conventional charts which cover more than a month and a very large area. We have chosen therefore, as stated earlier, to leave all such comments to the Part III section entitled "Special Topics."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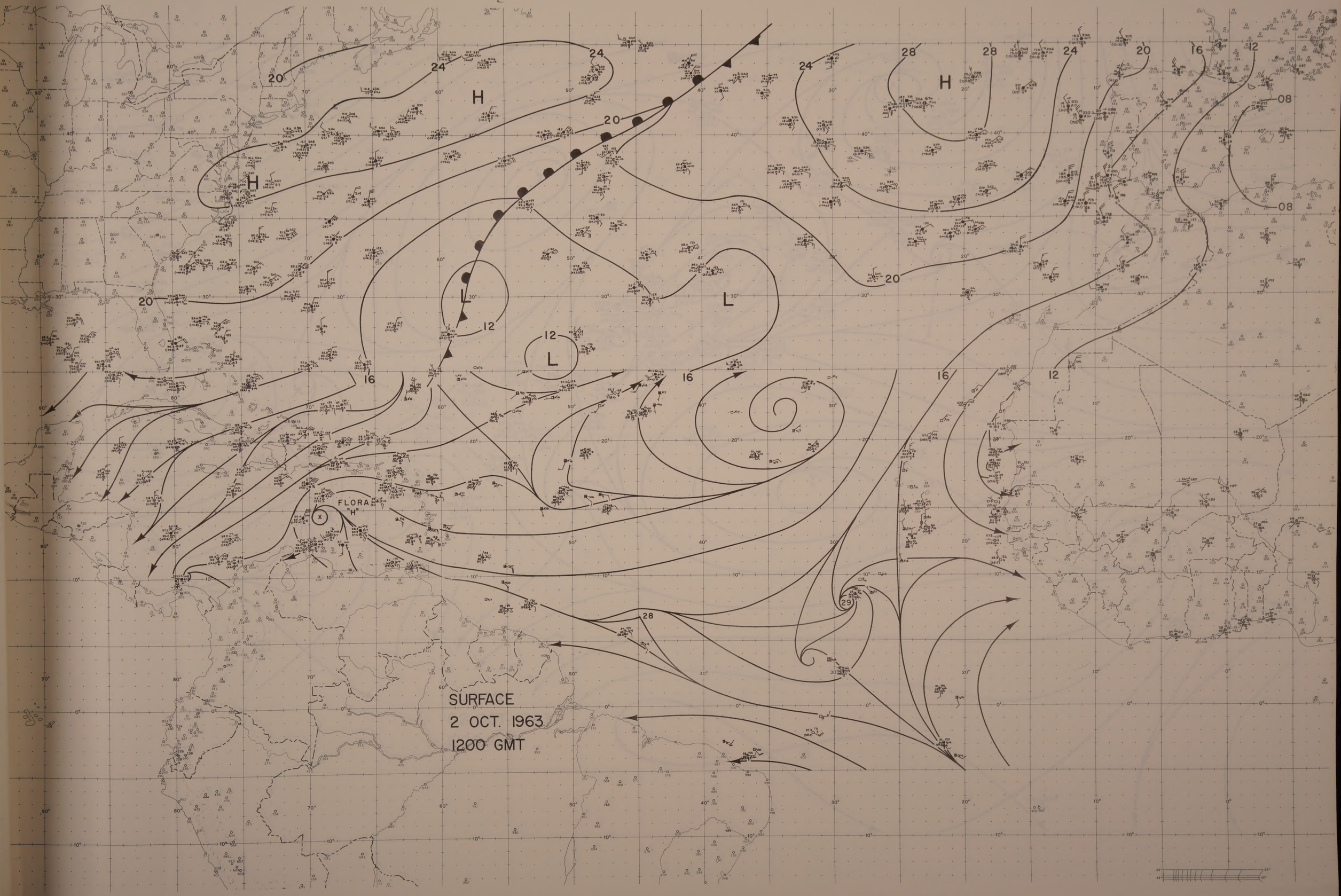
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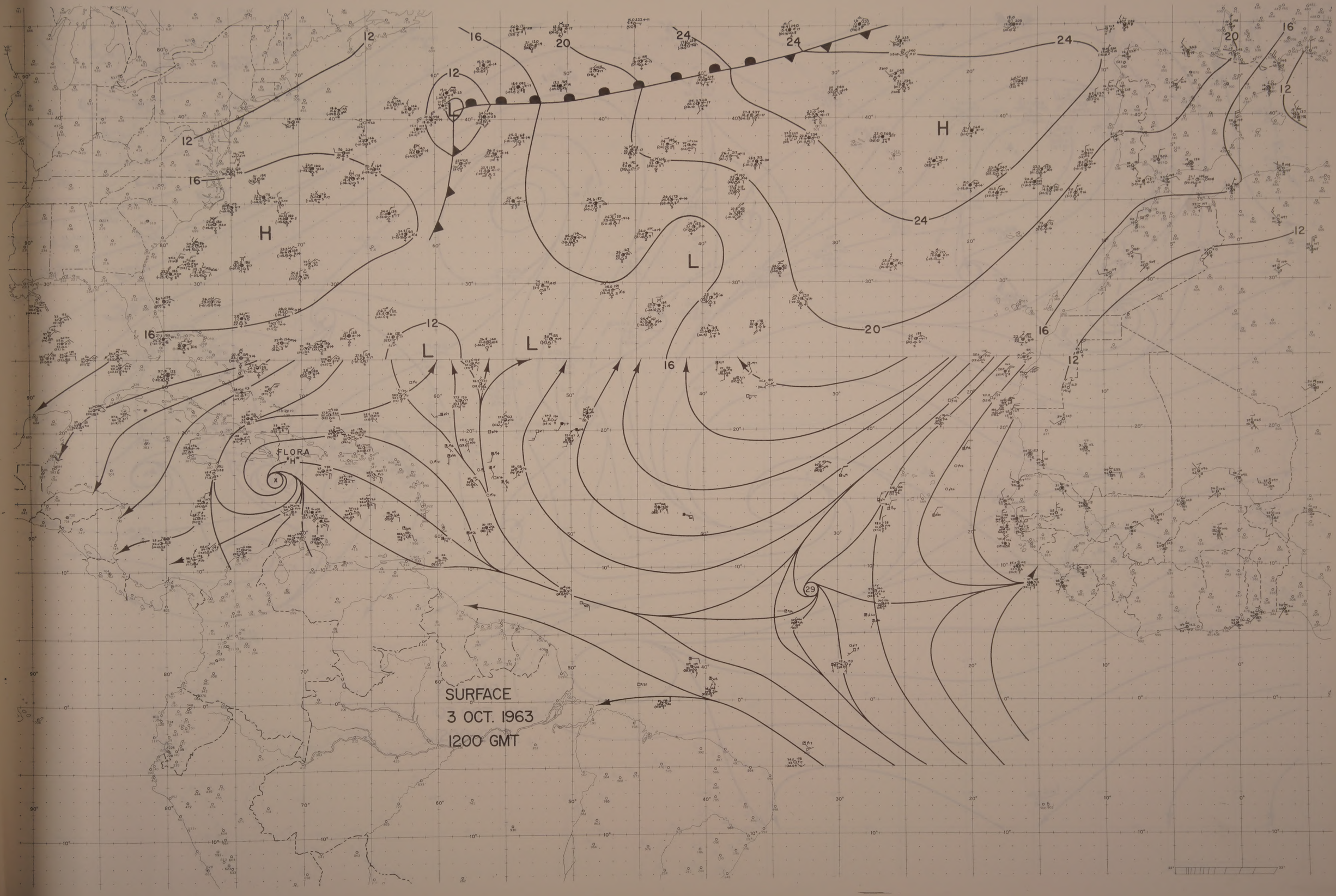
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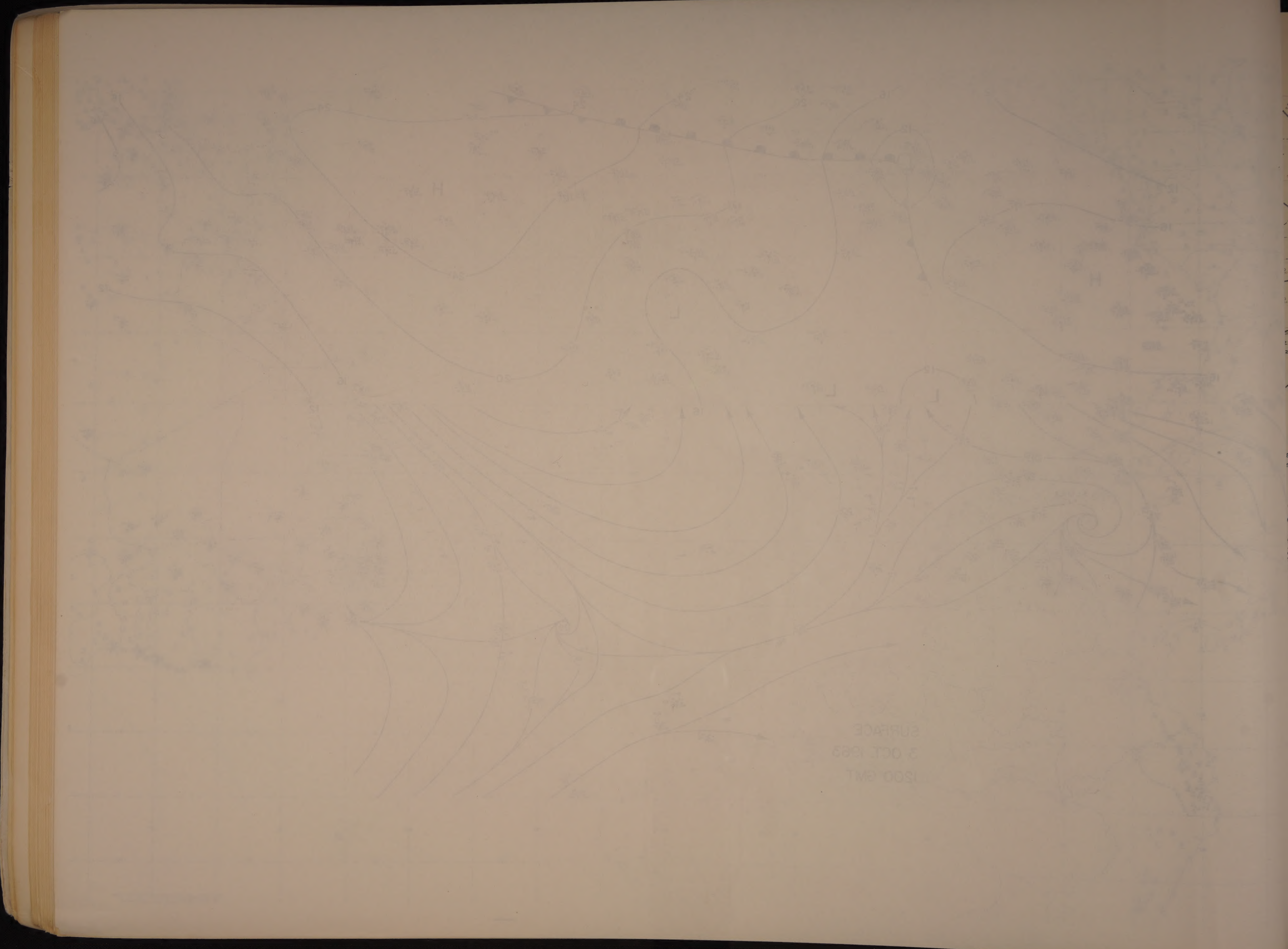

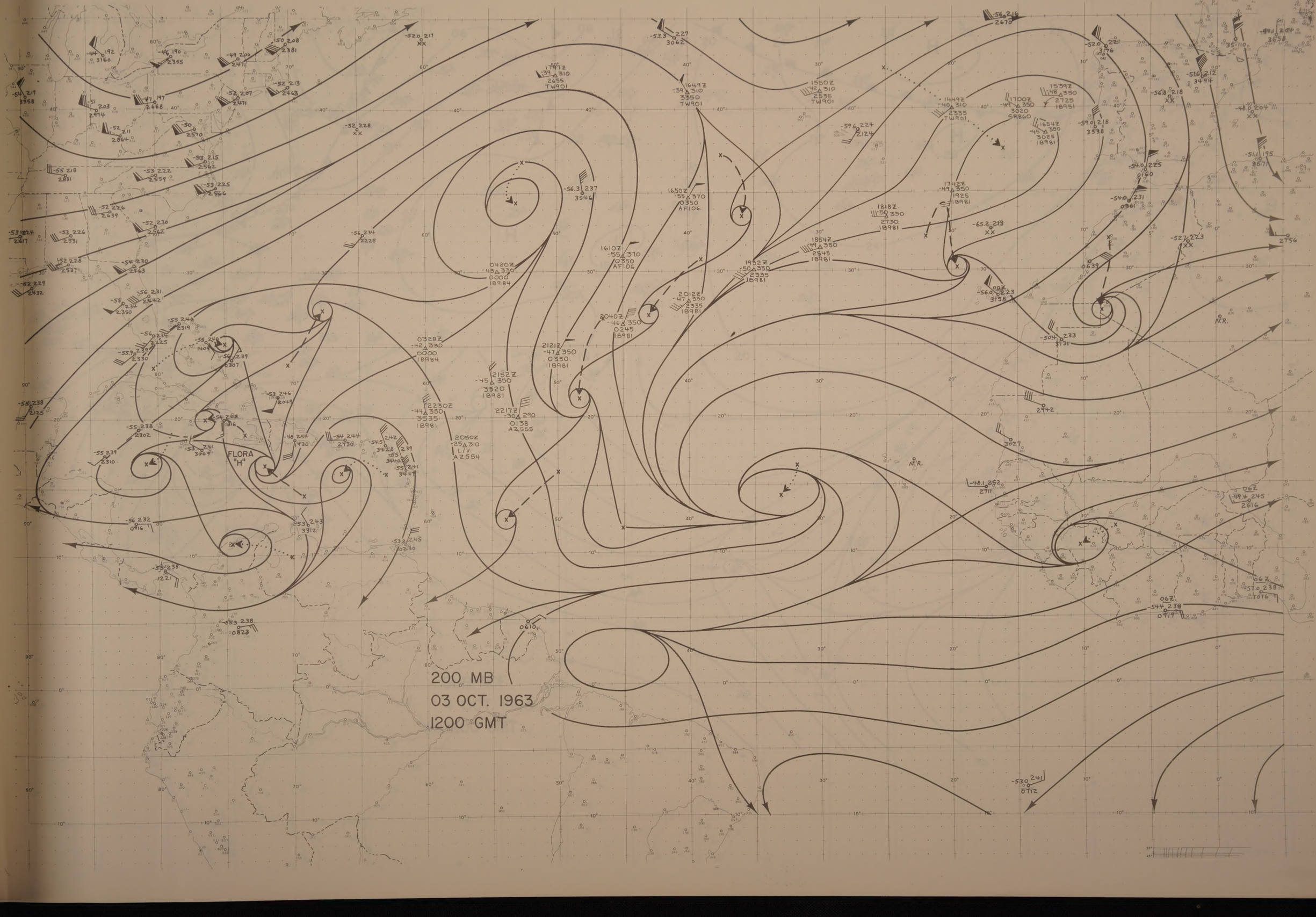
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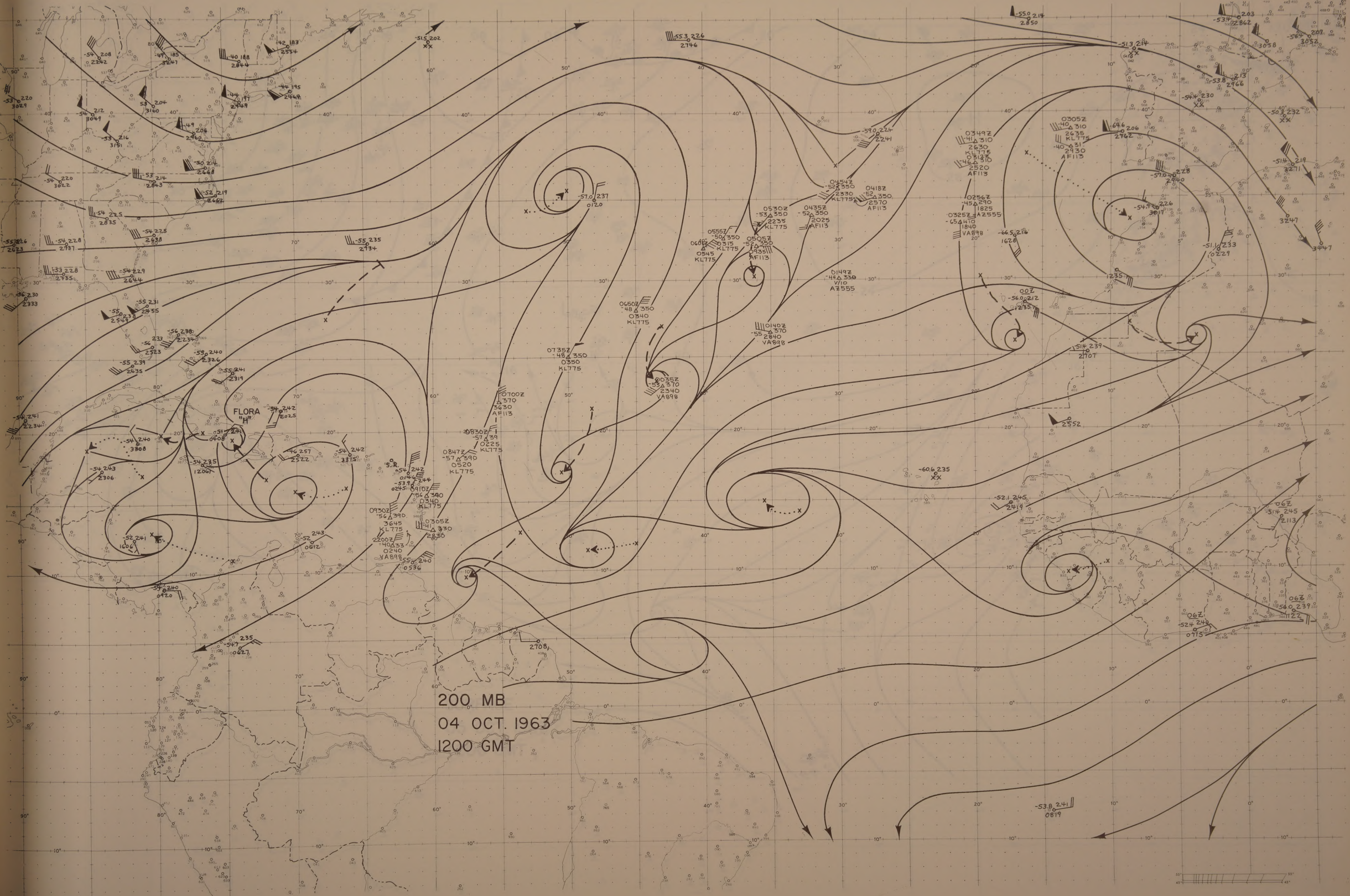
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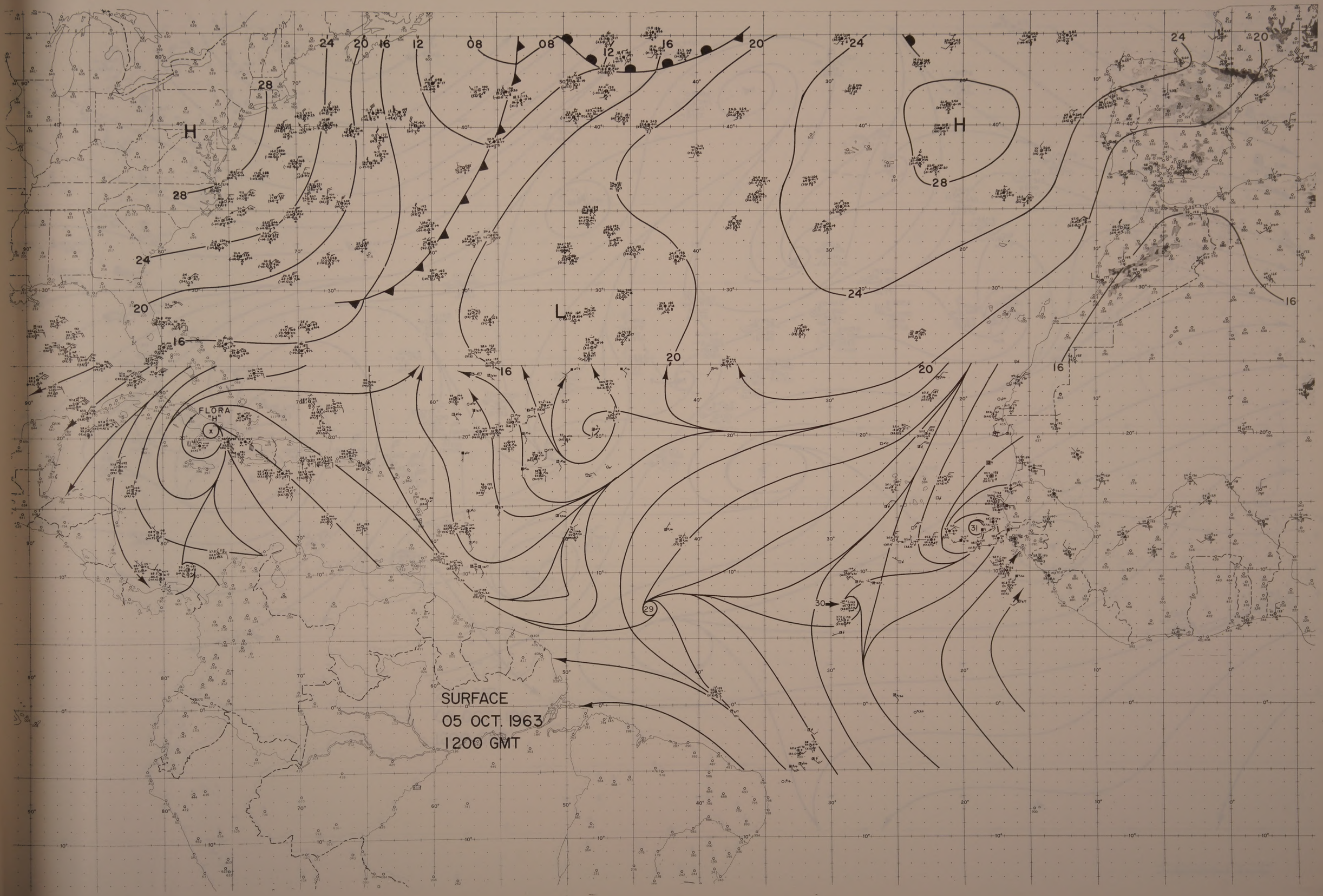
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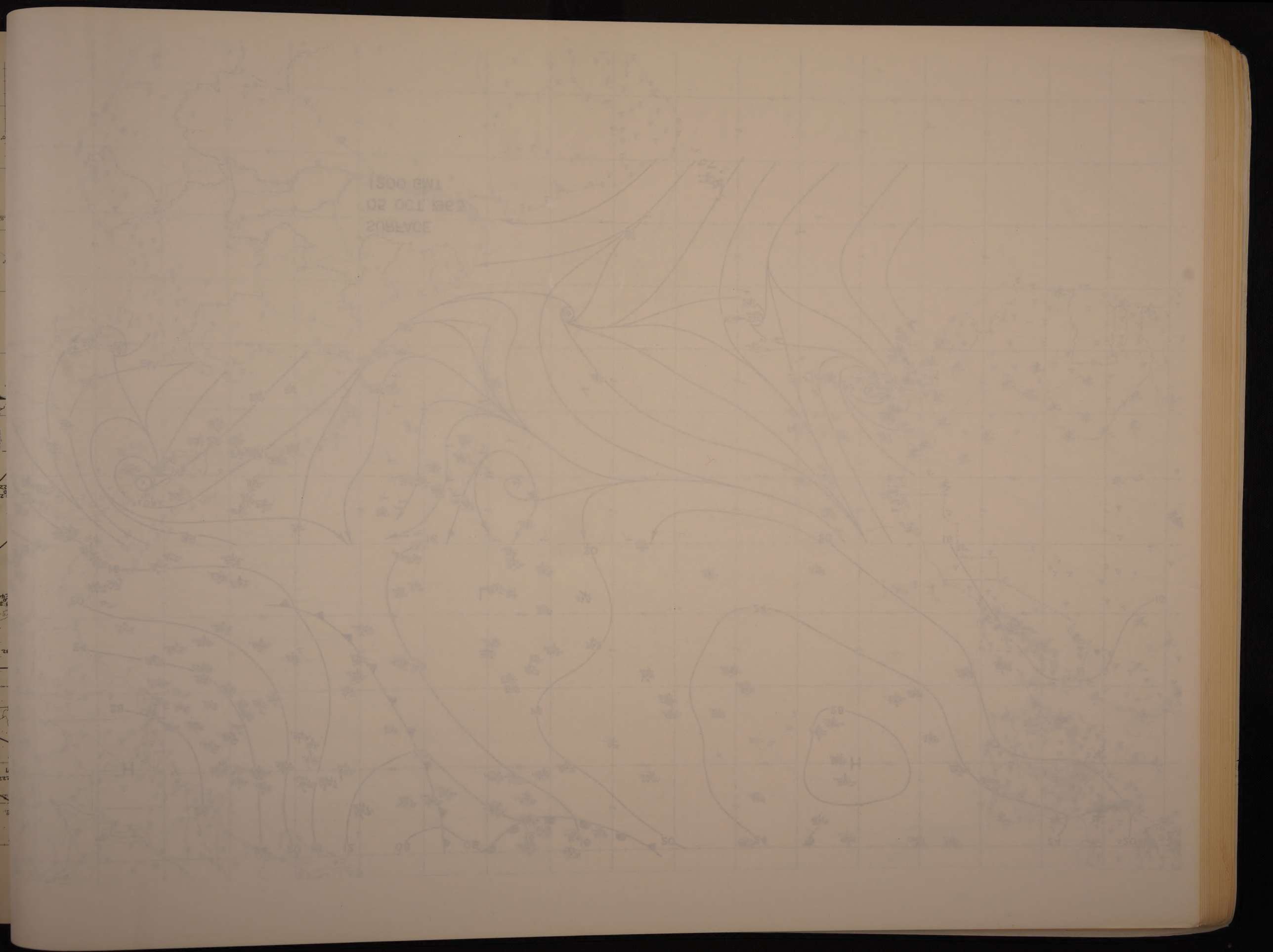
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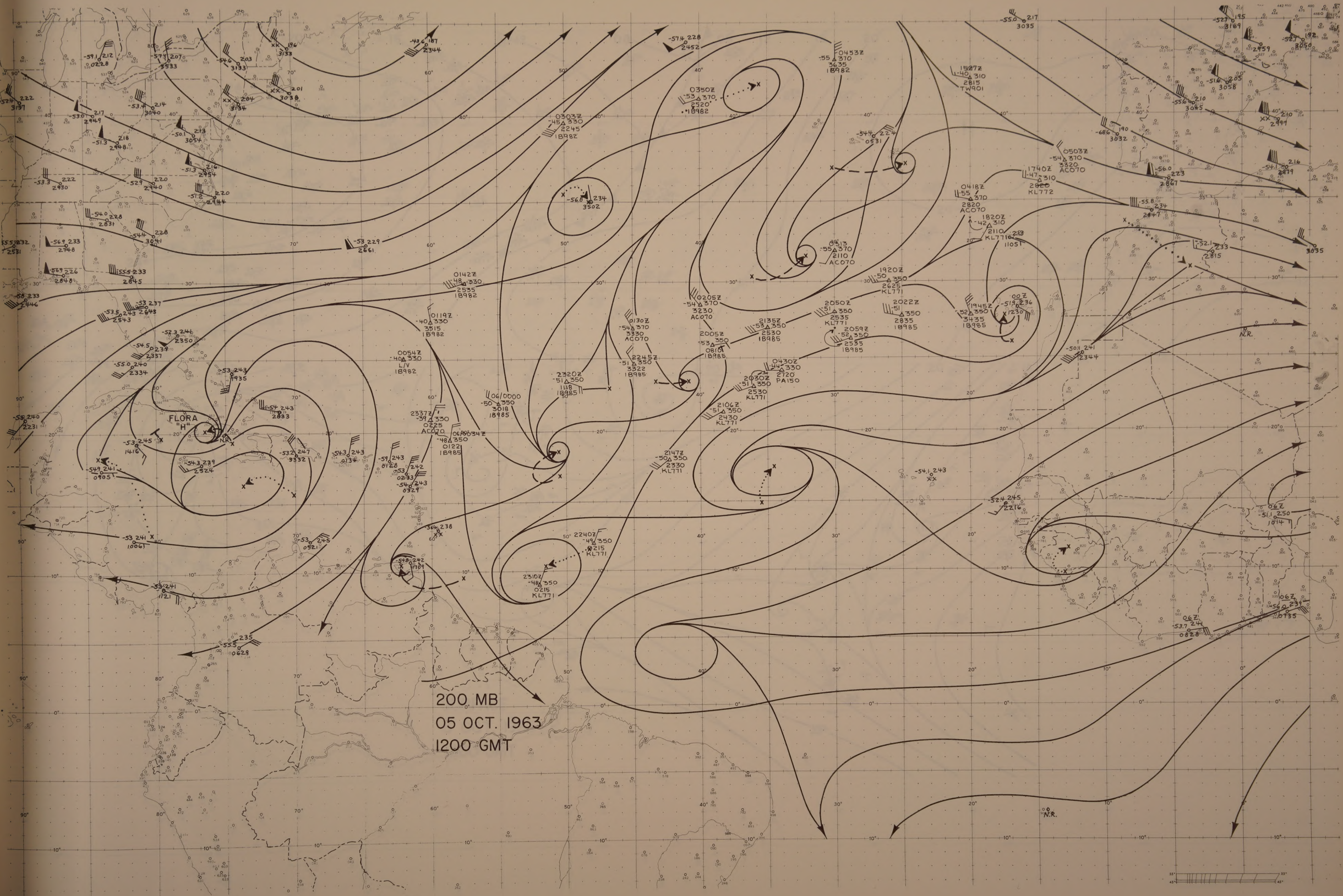
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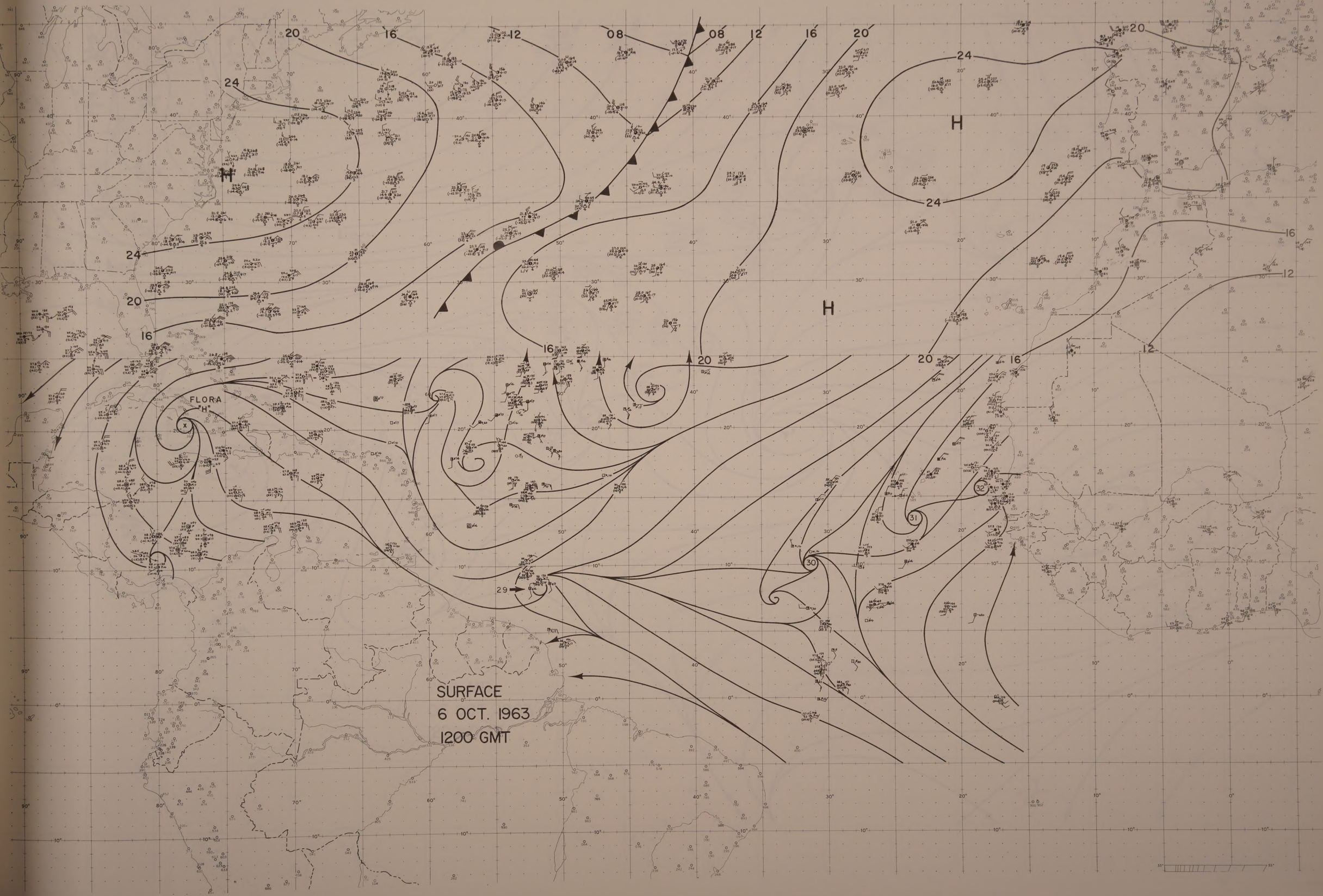
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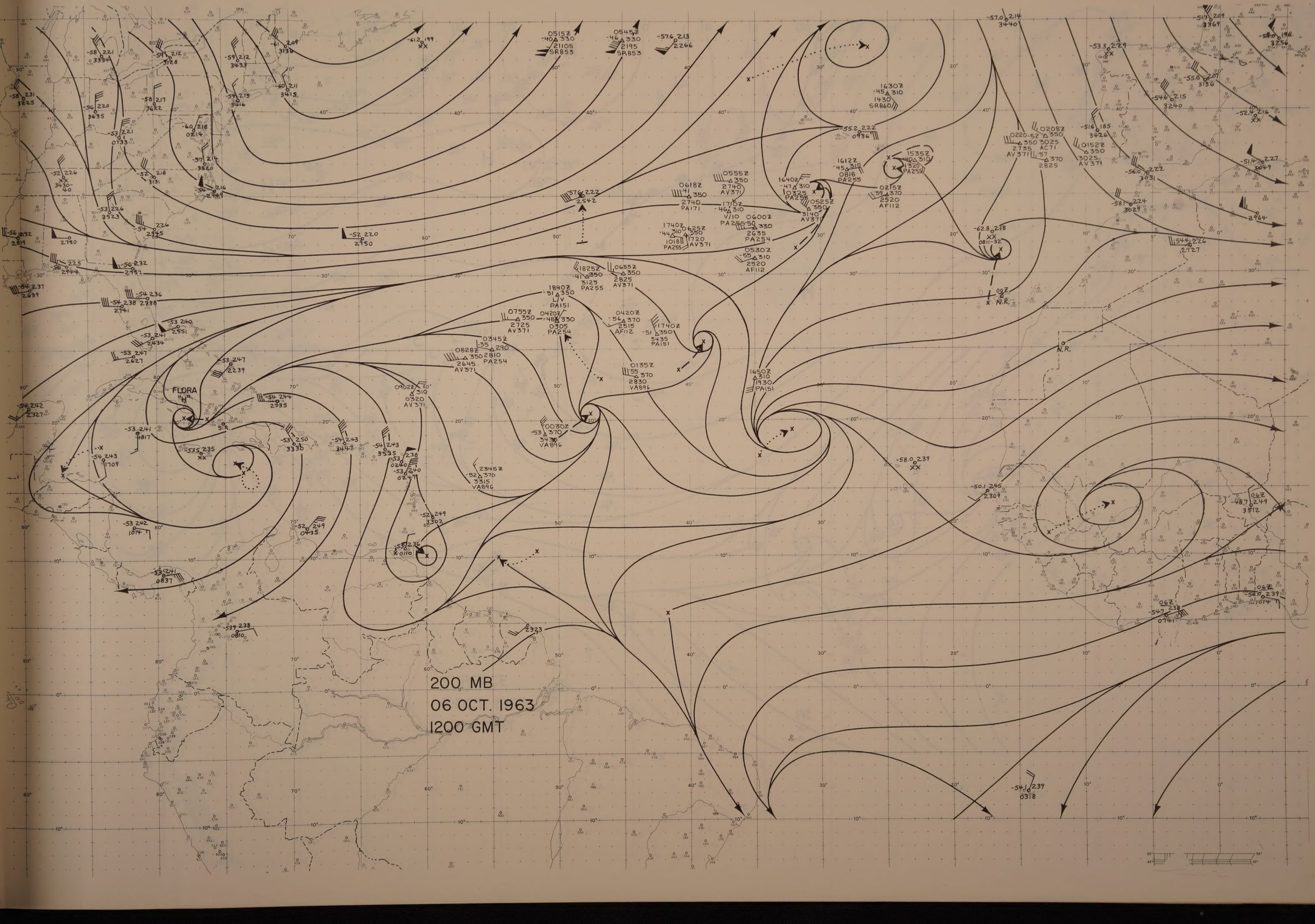
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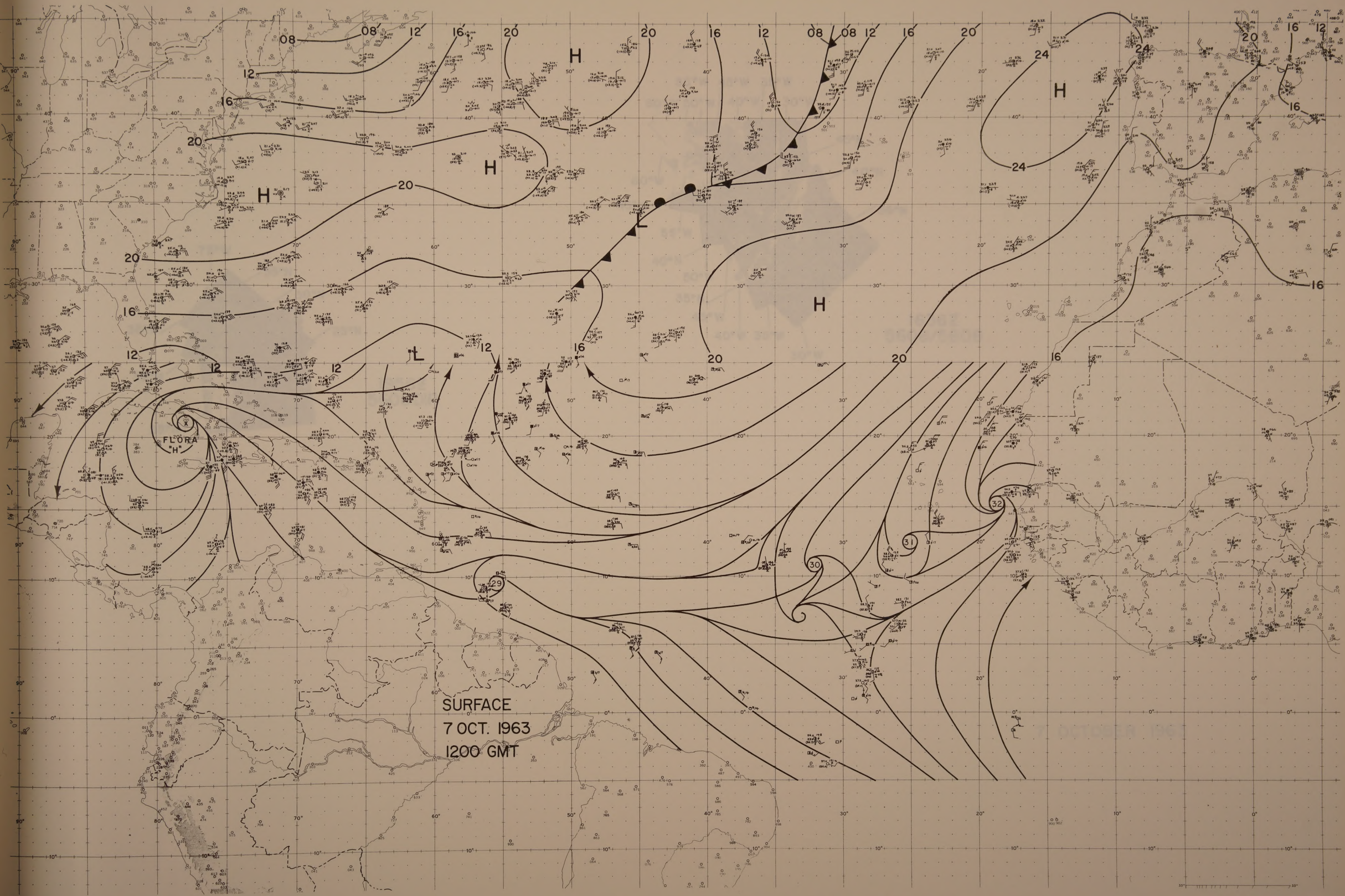
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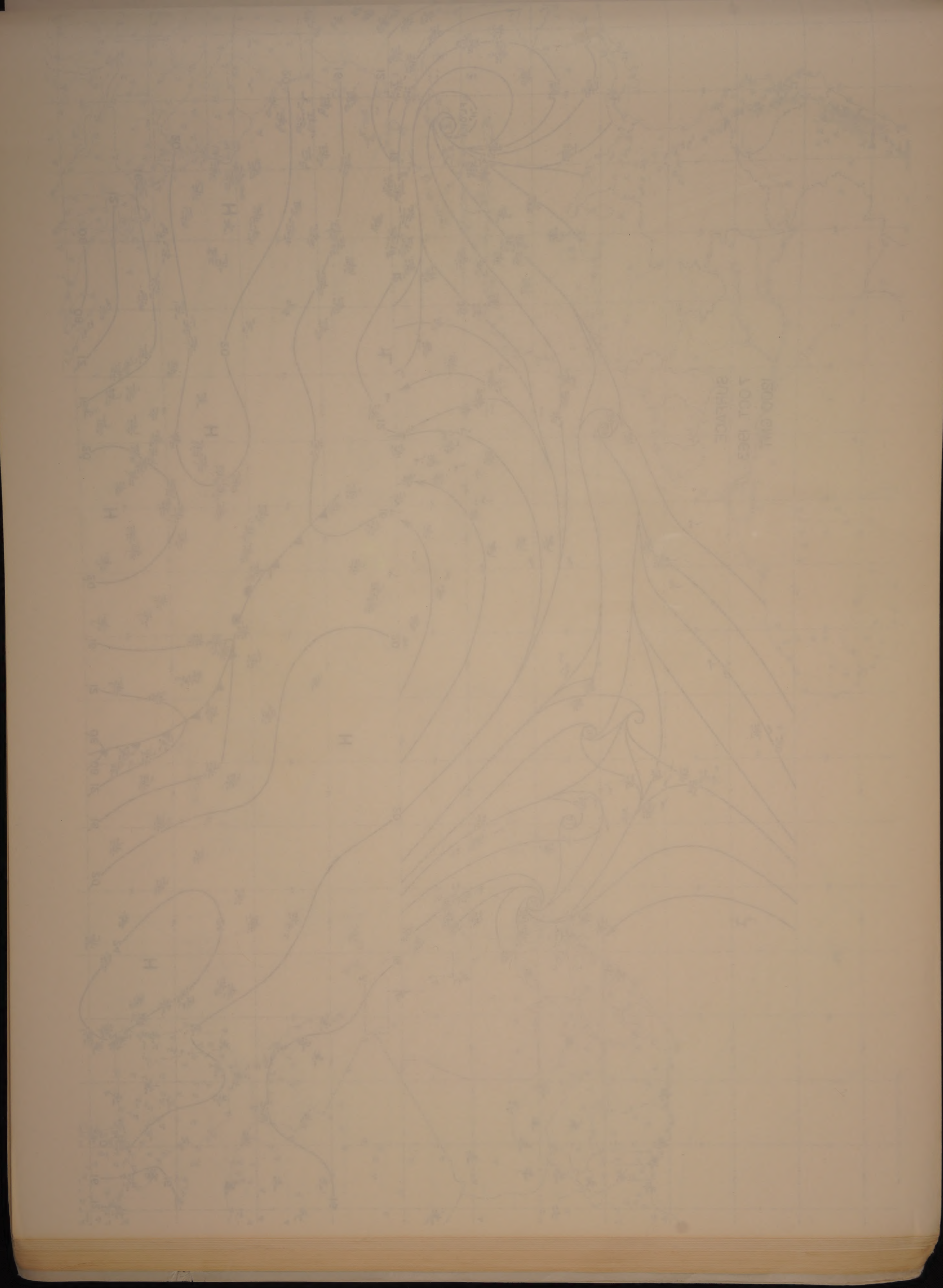

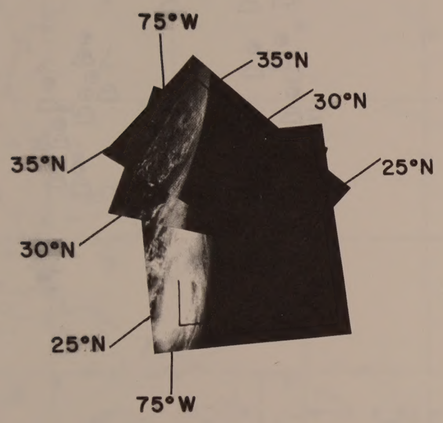

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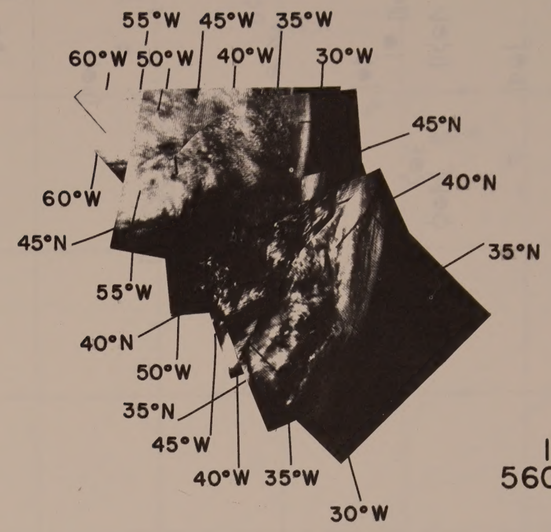

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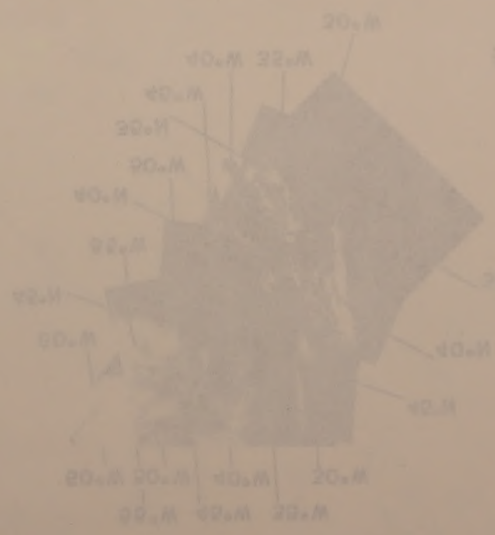

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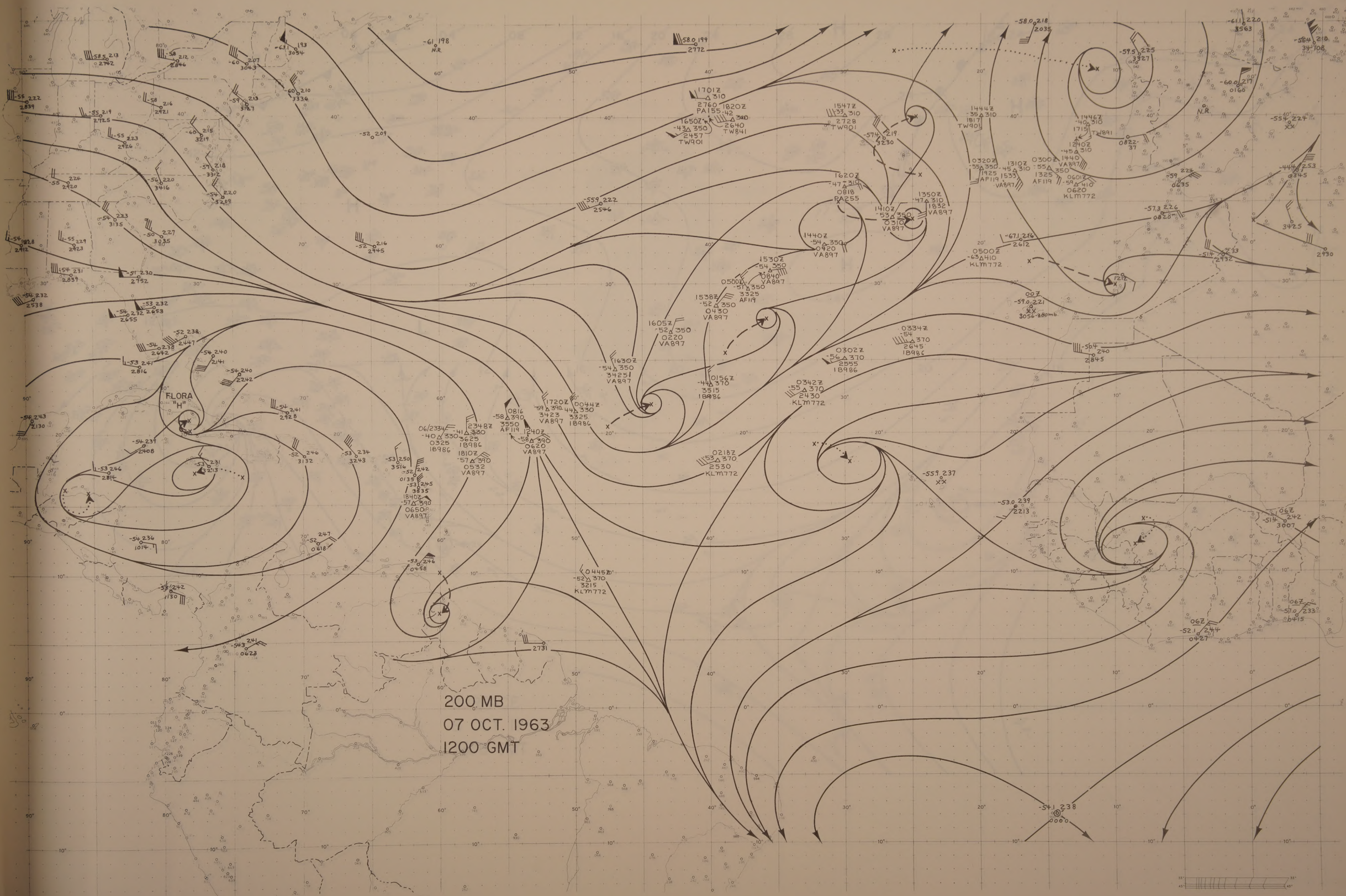
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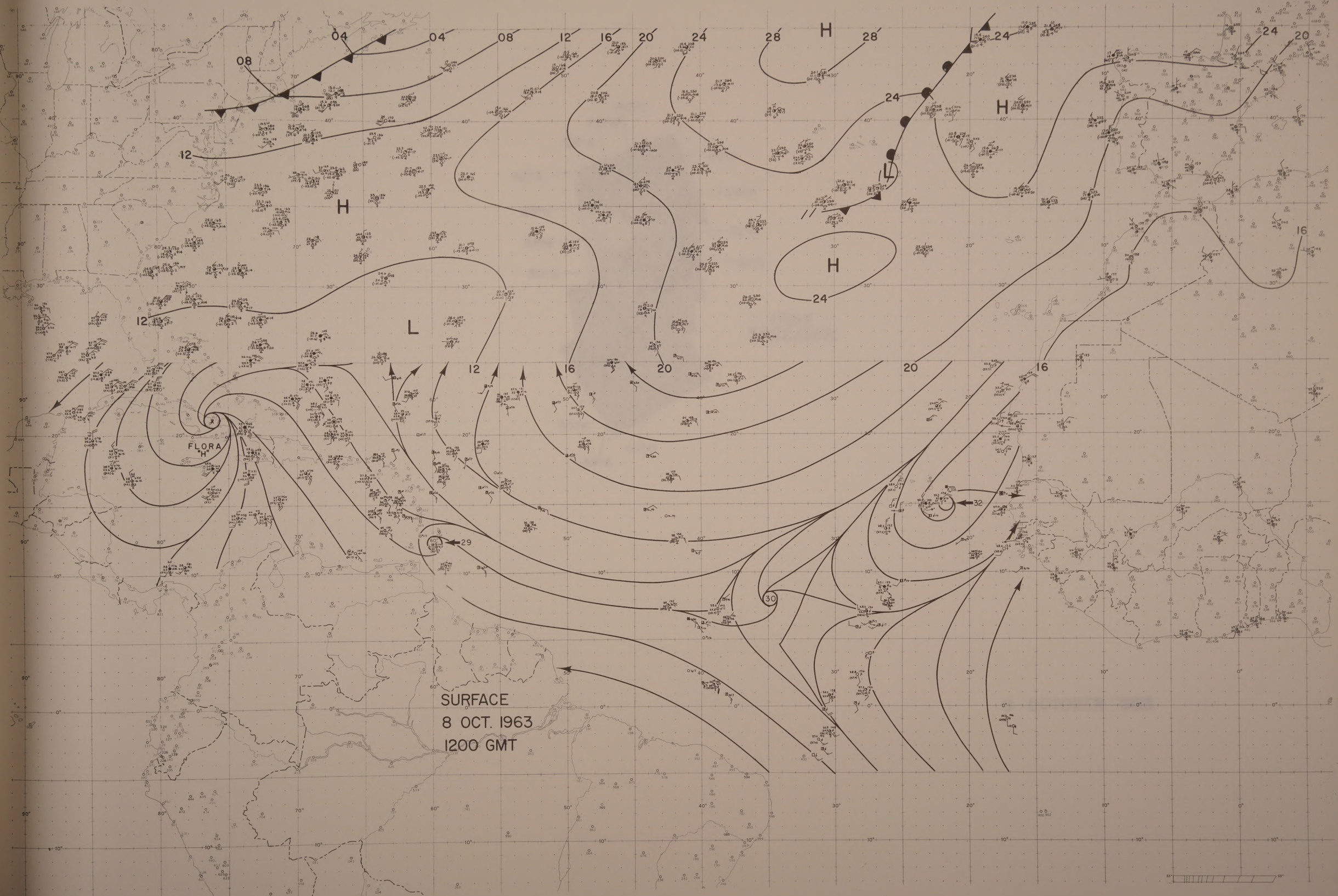
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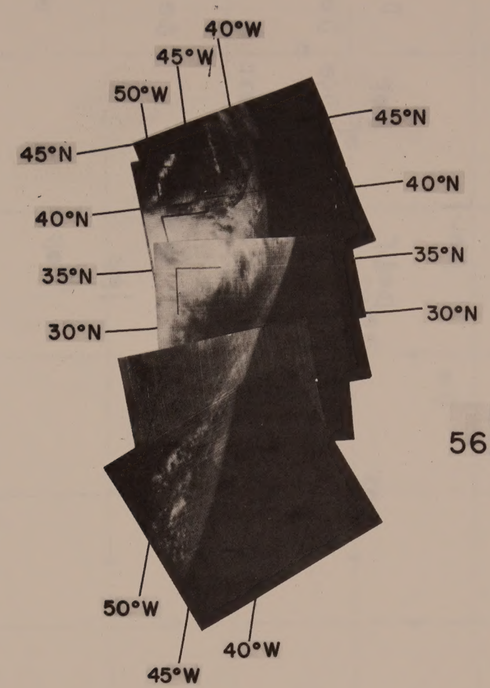

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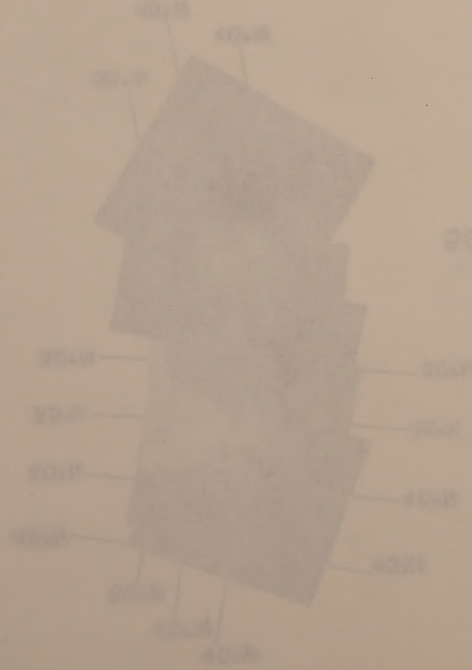

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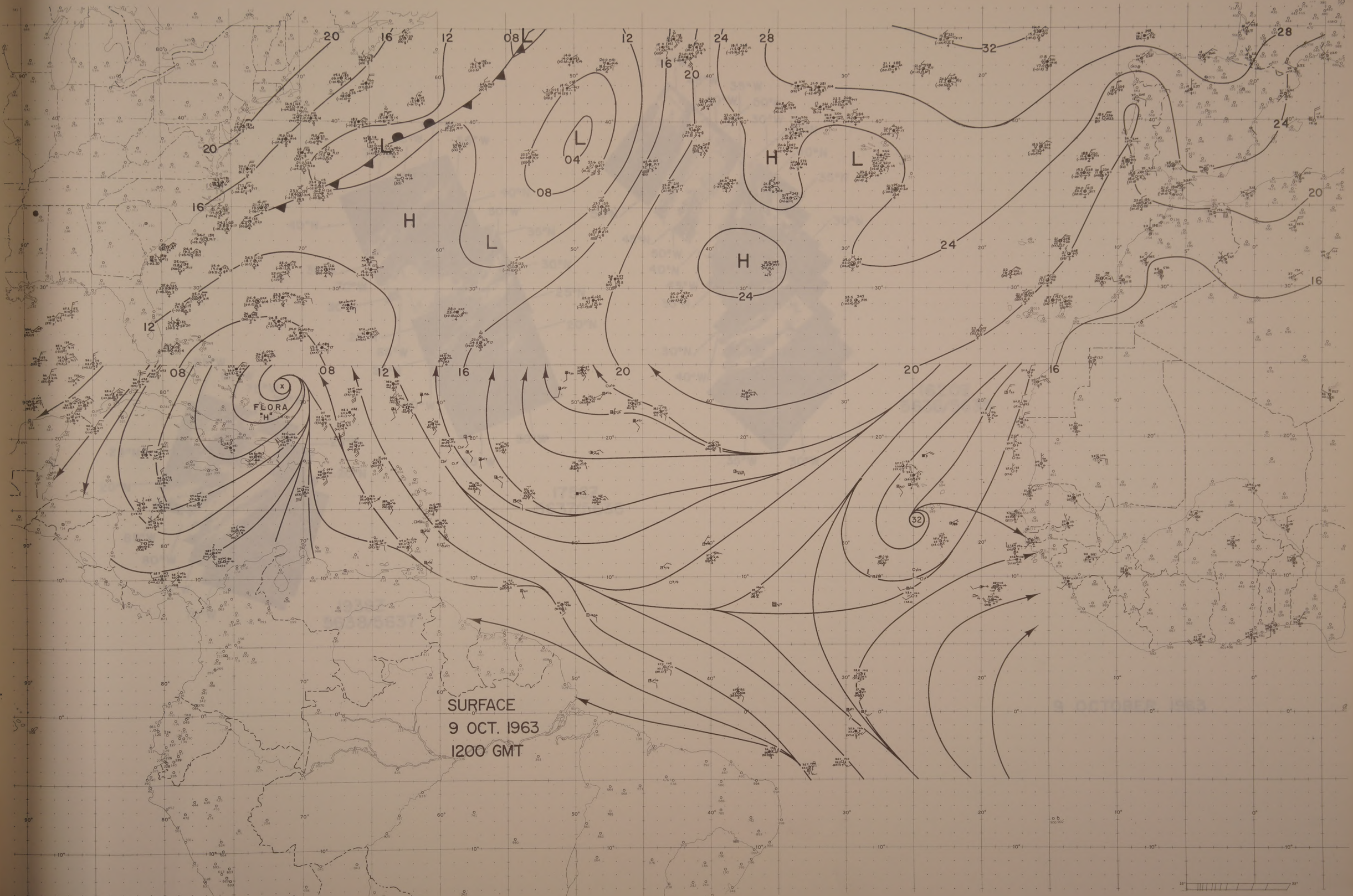
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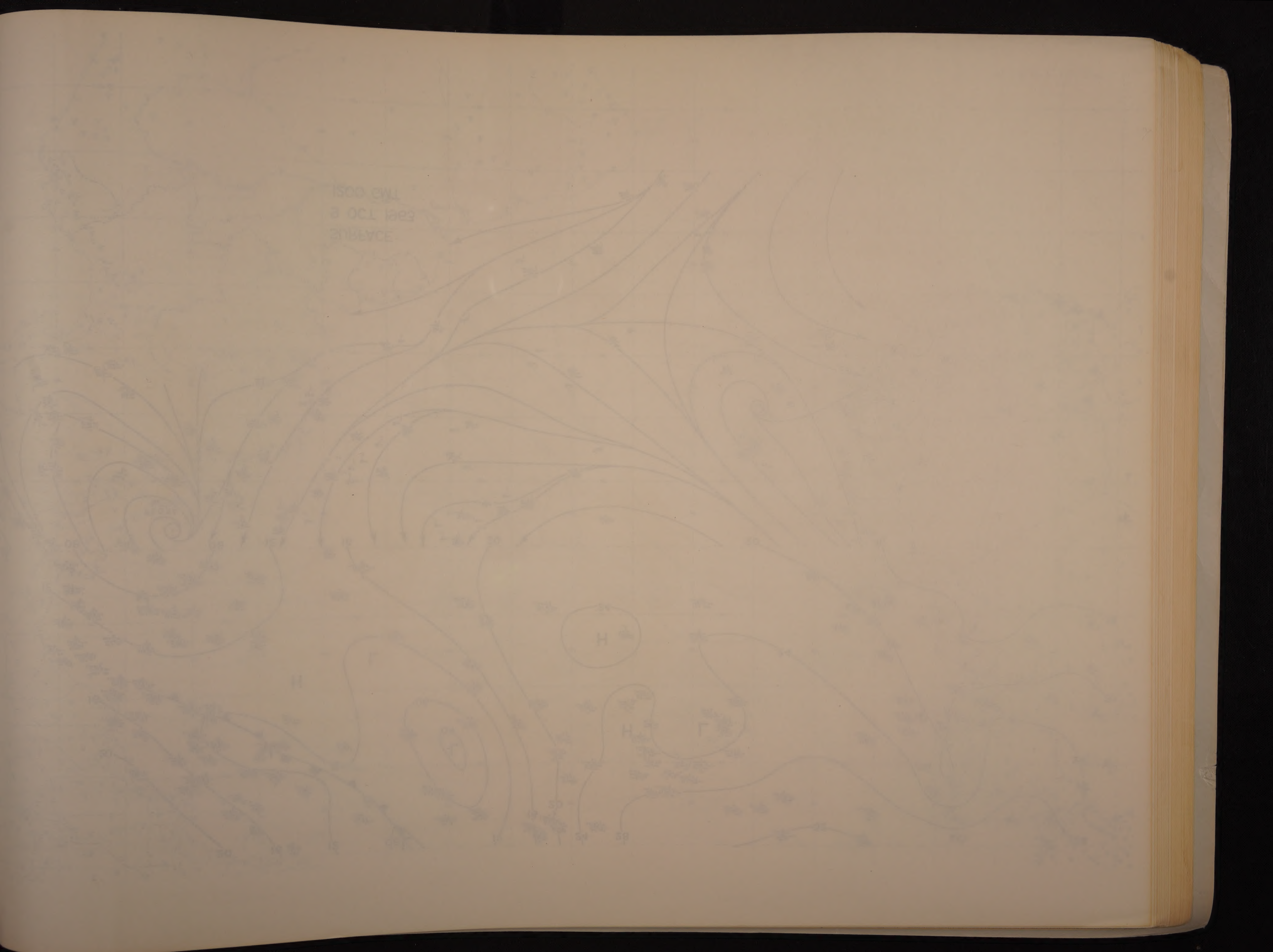

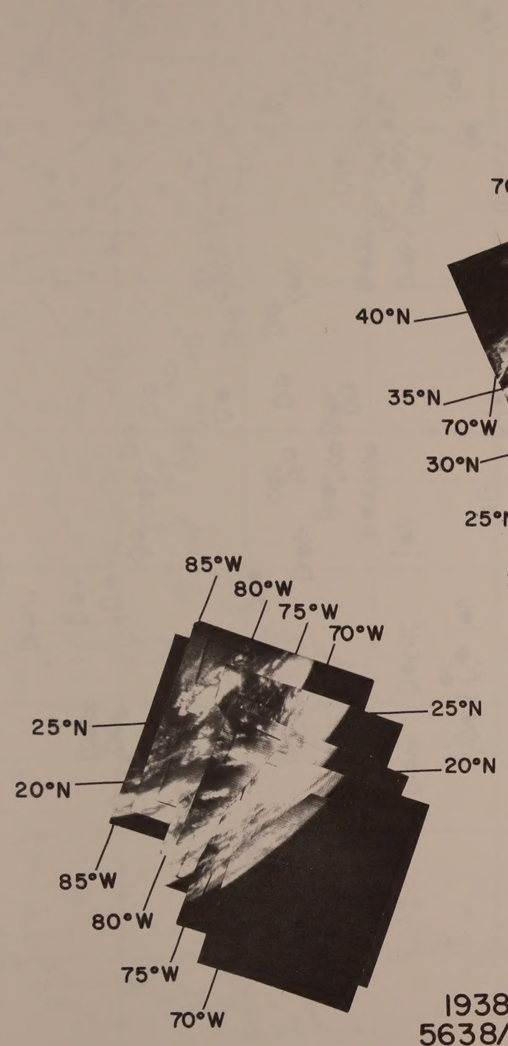

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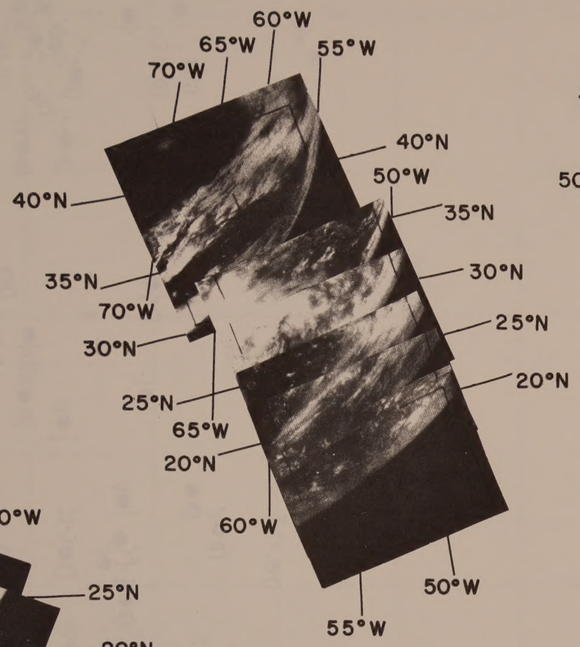

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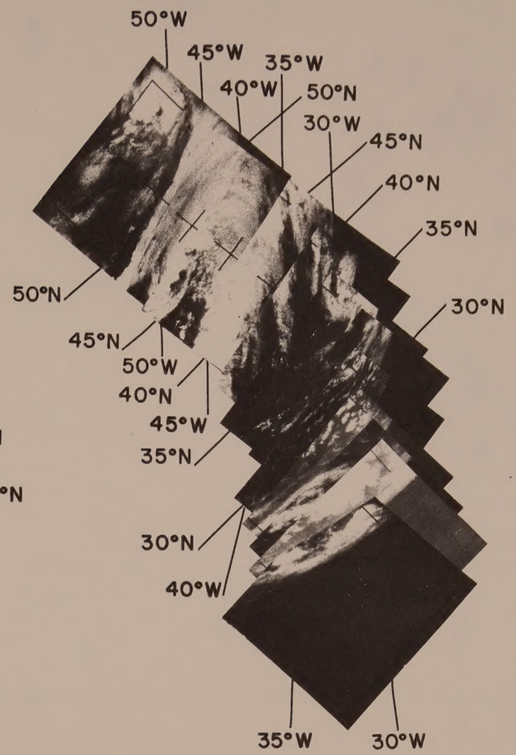

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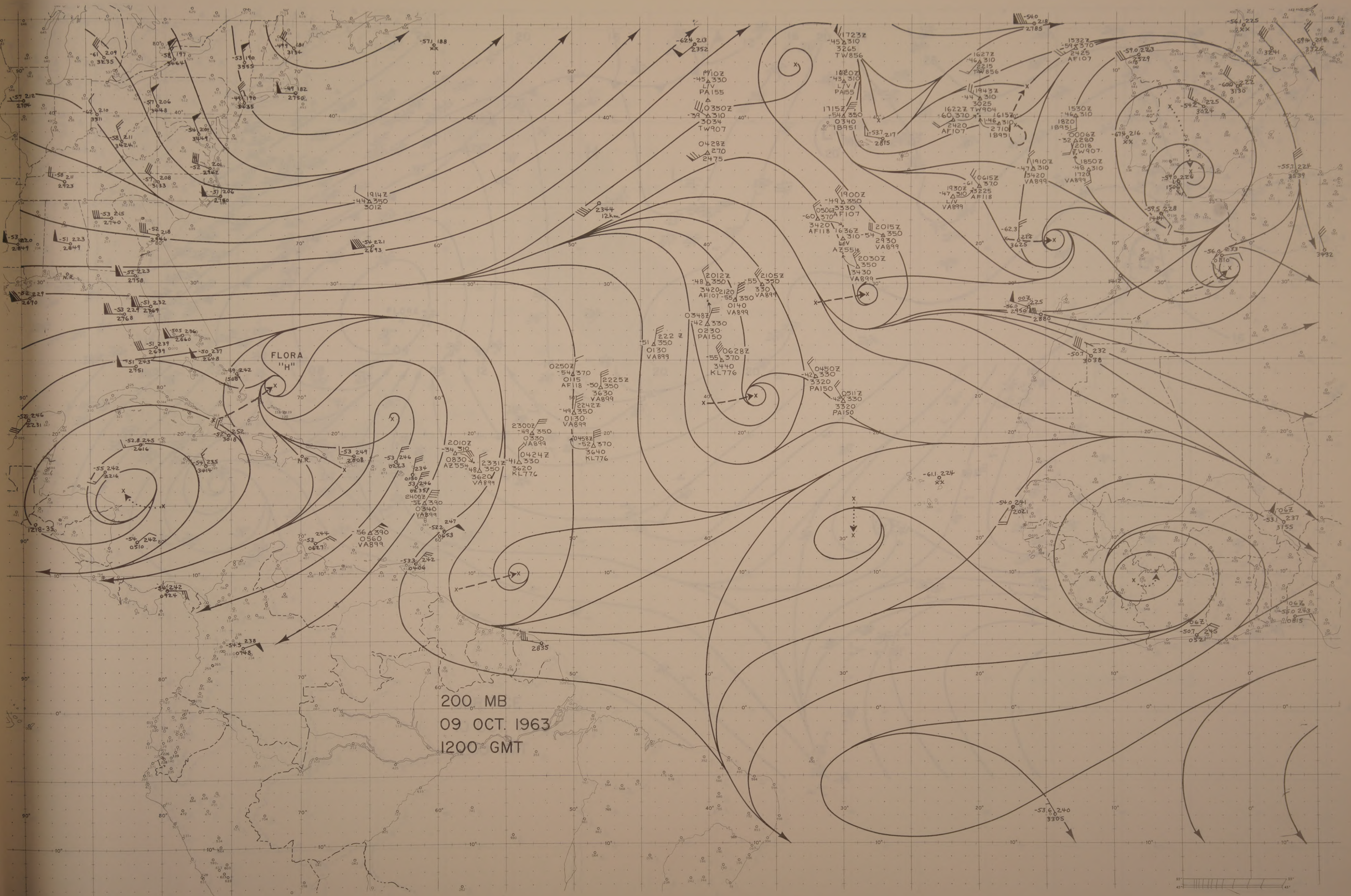
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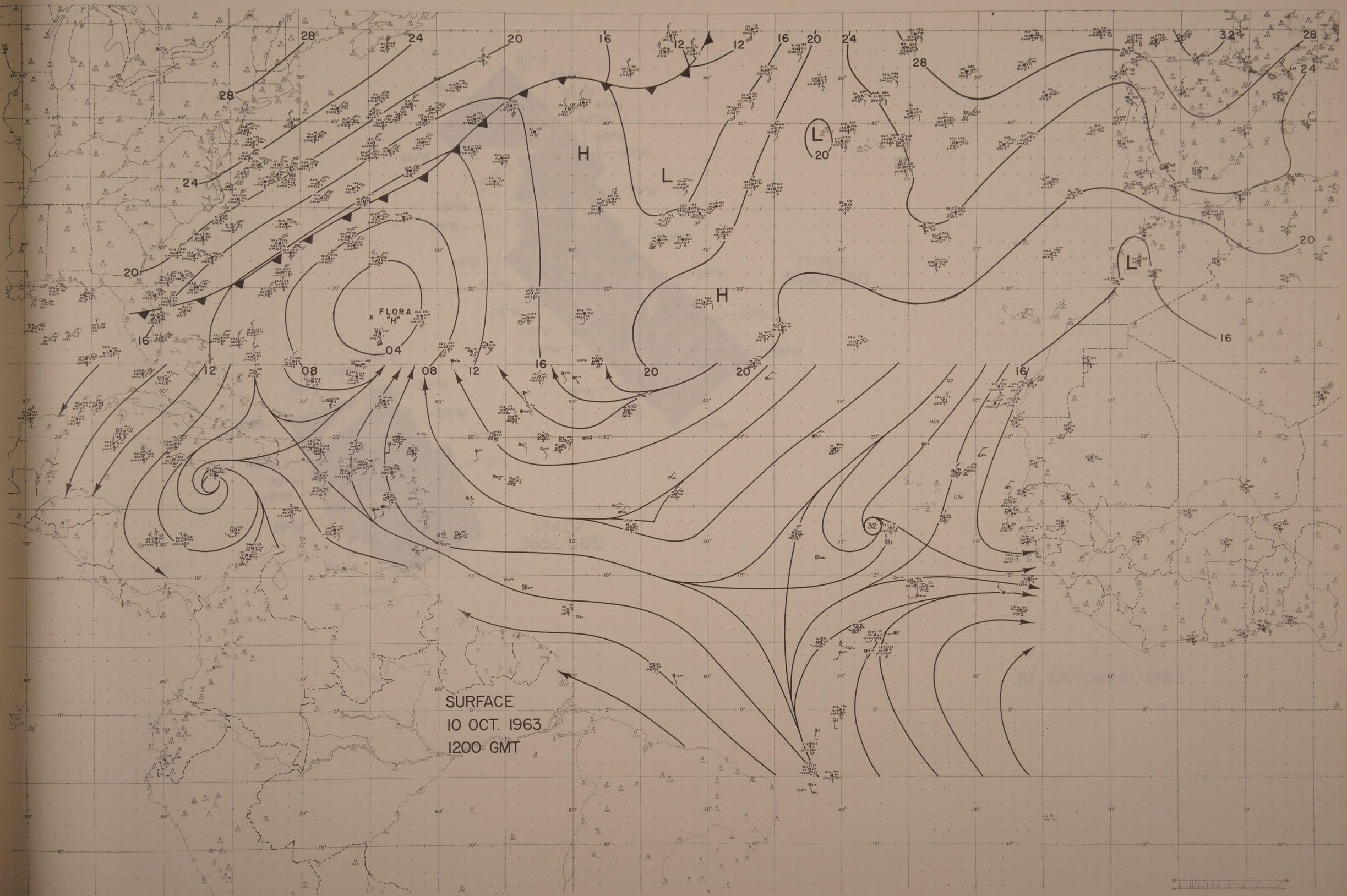
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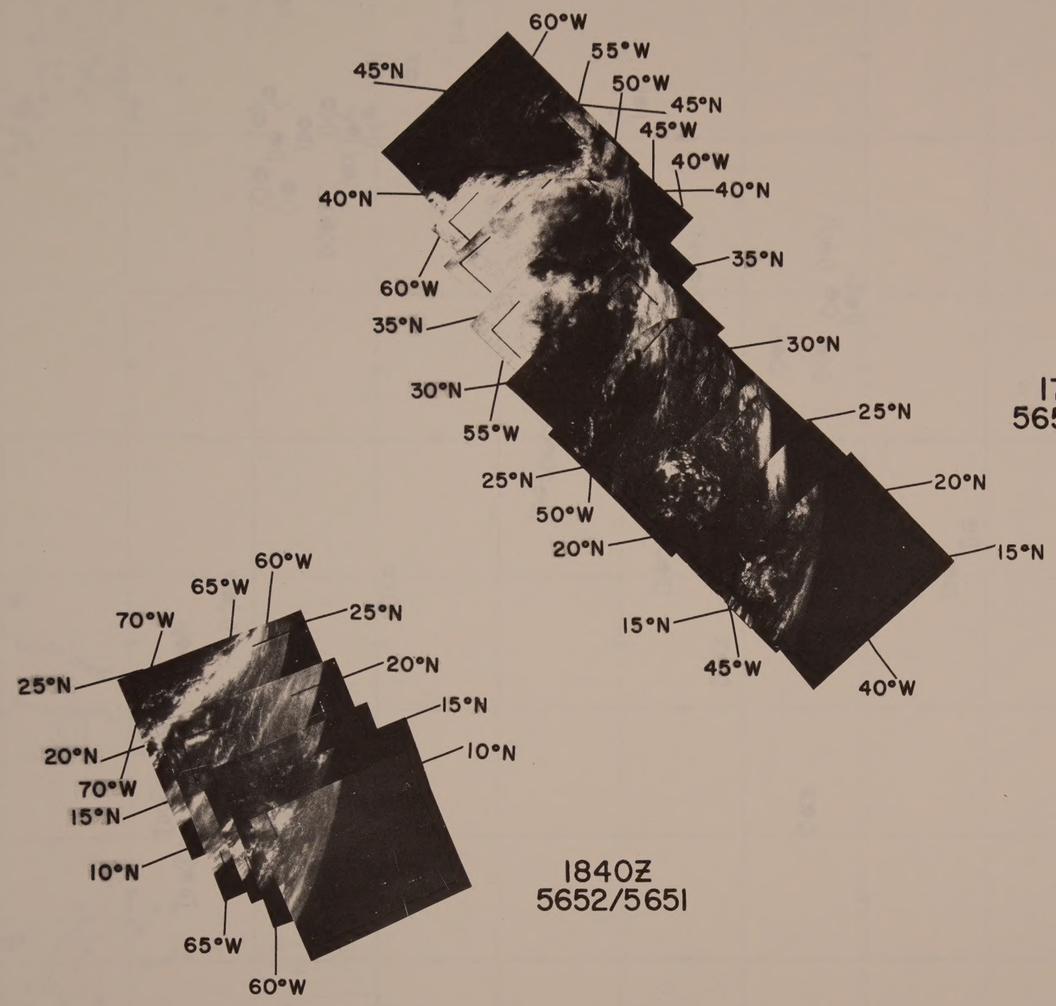

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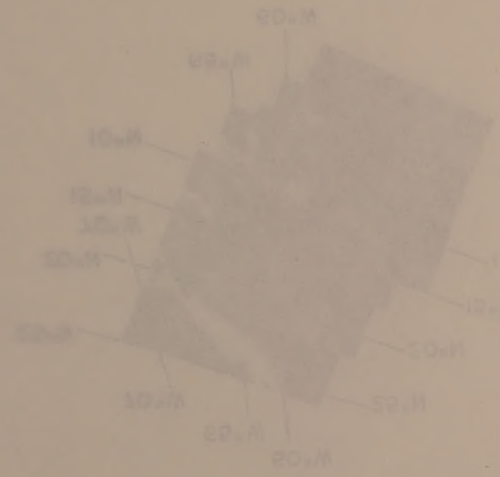

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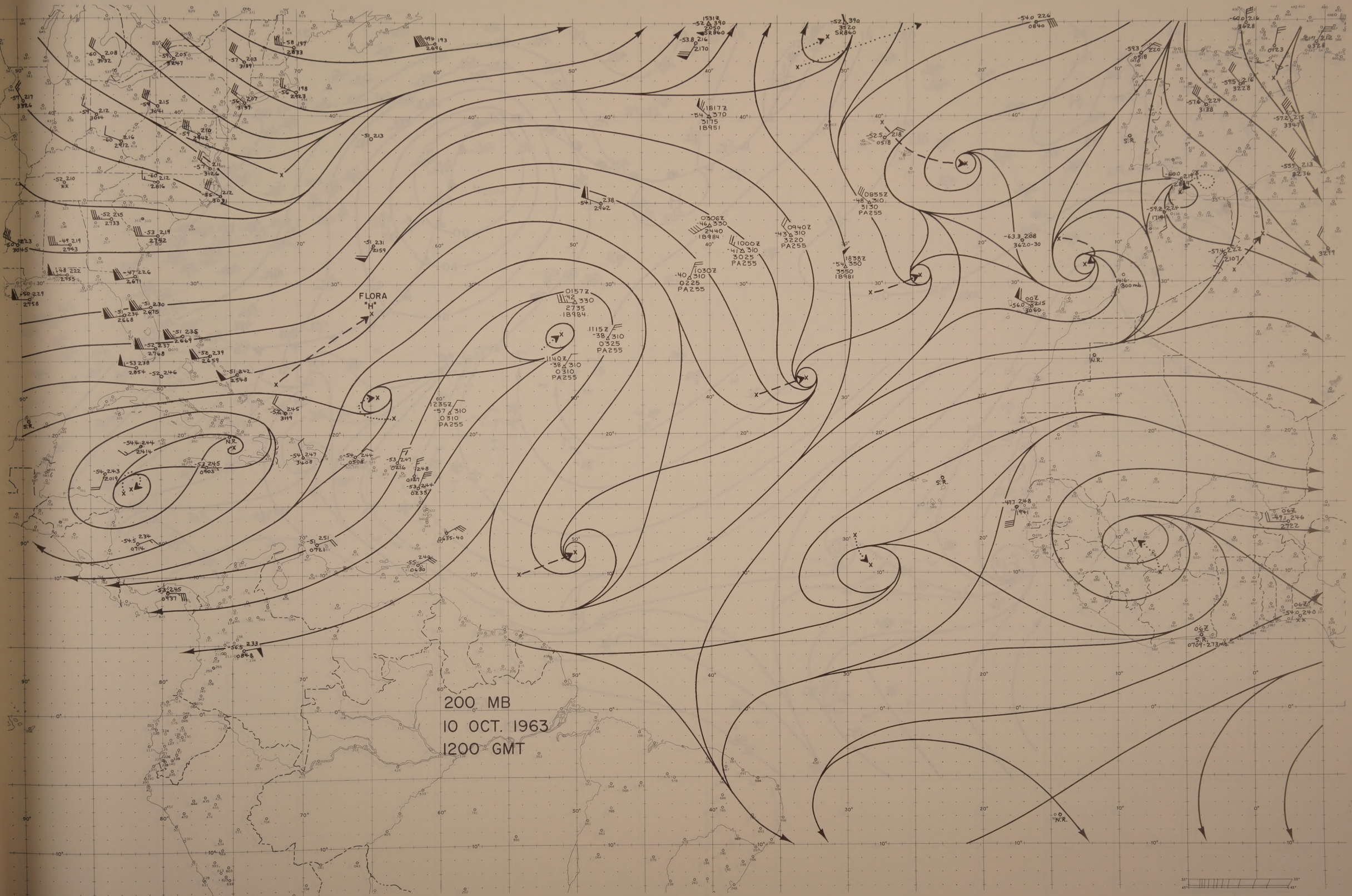
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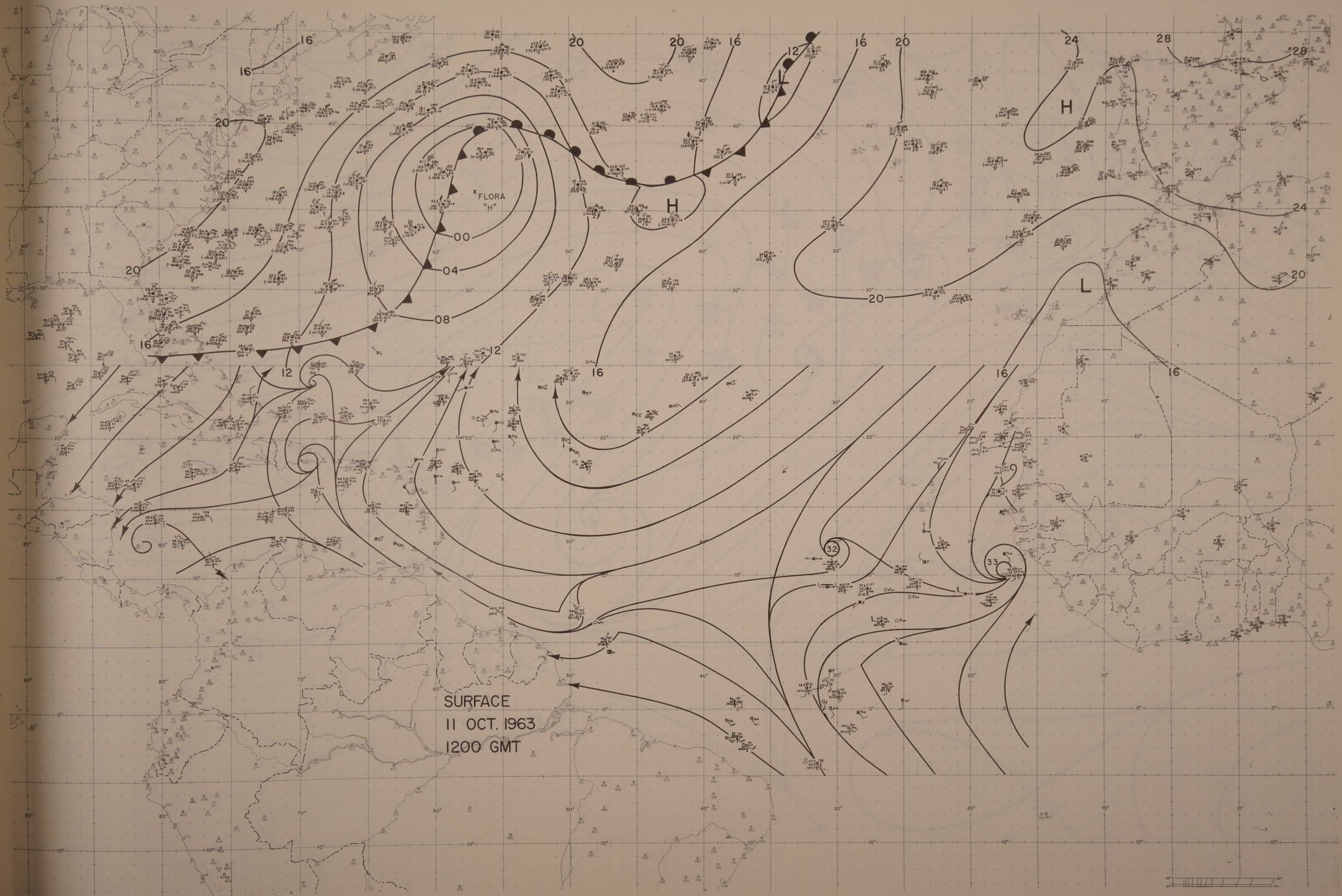
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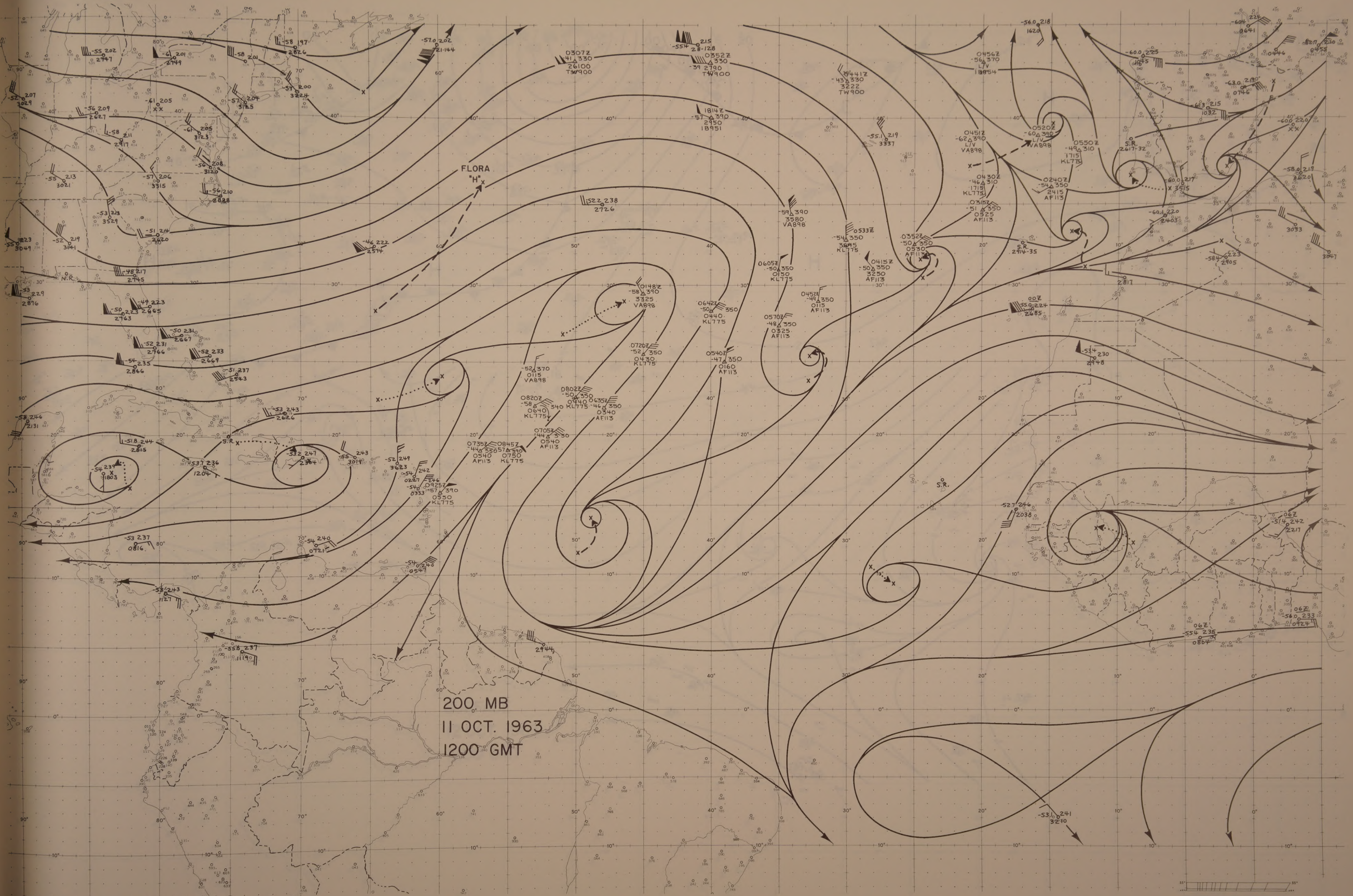
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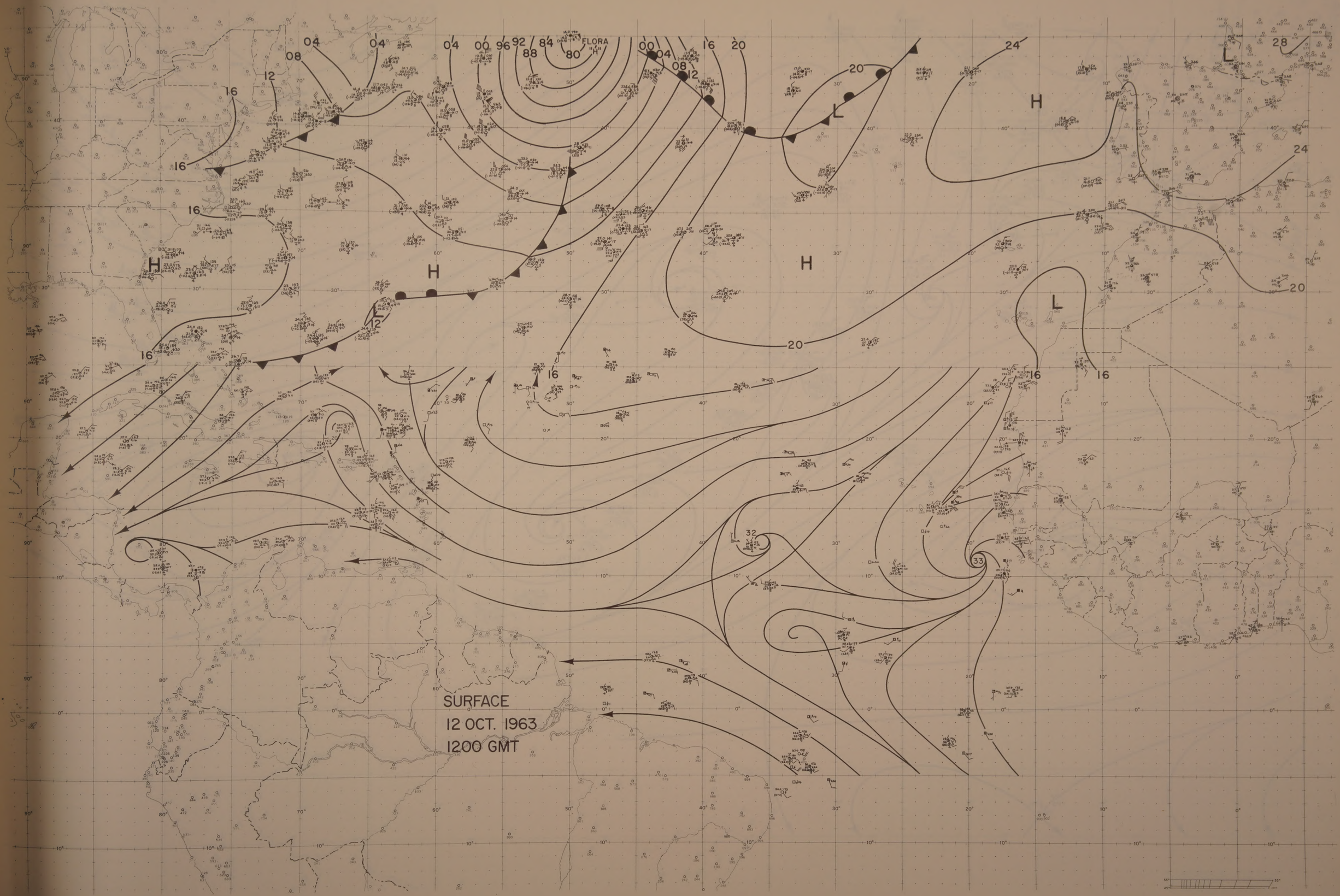
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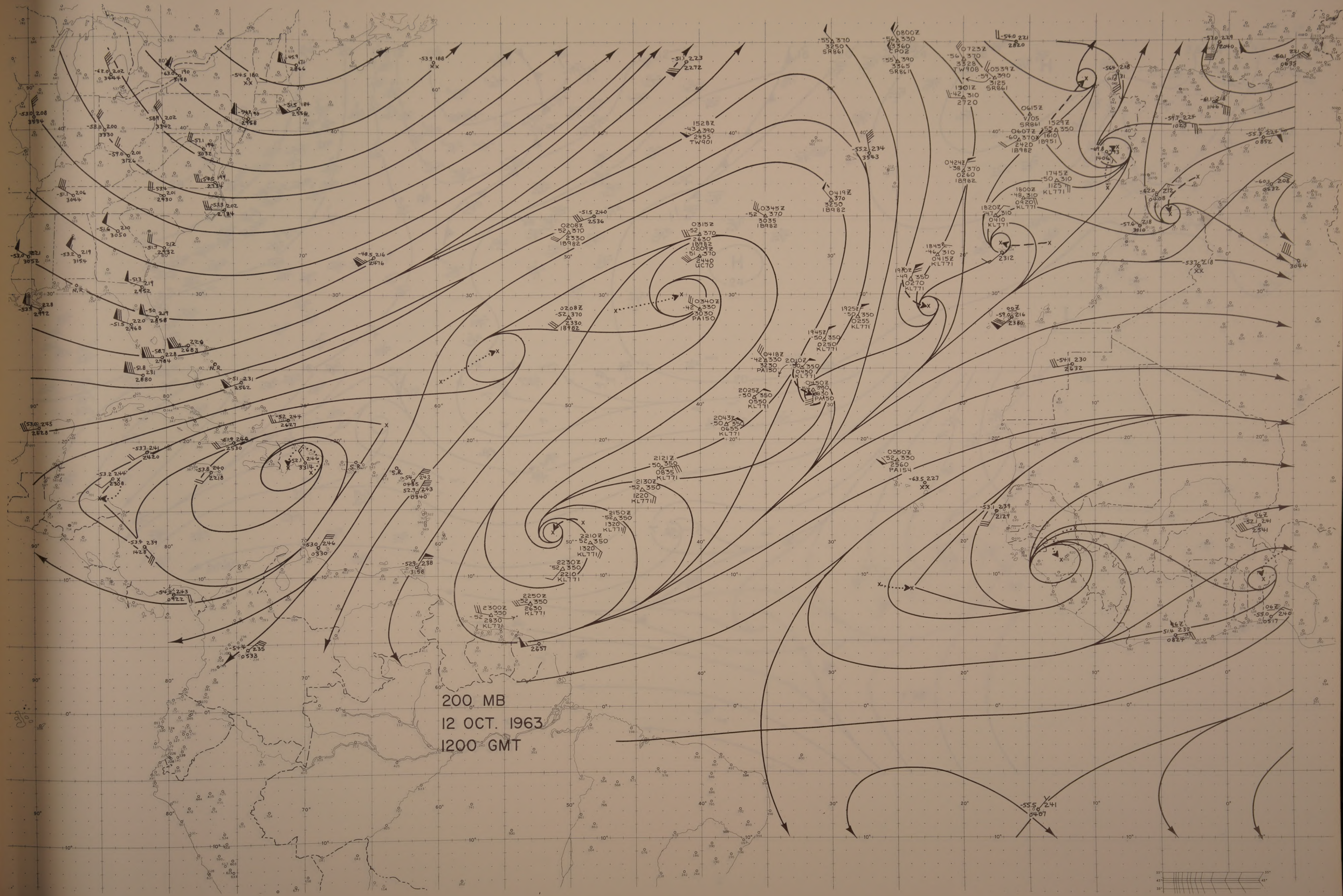
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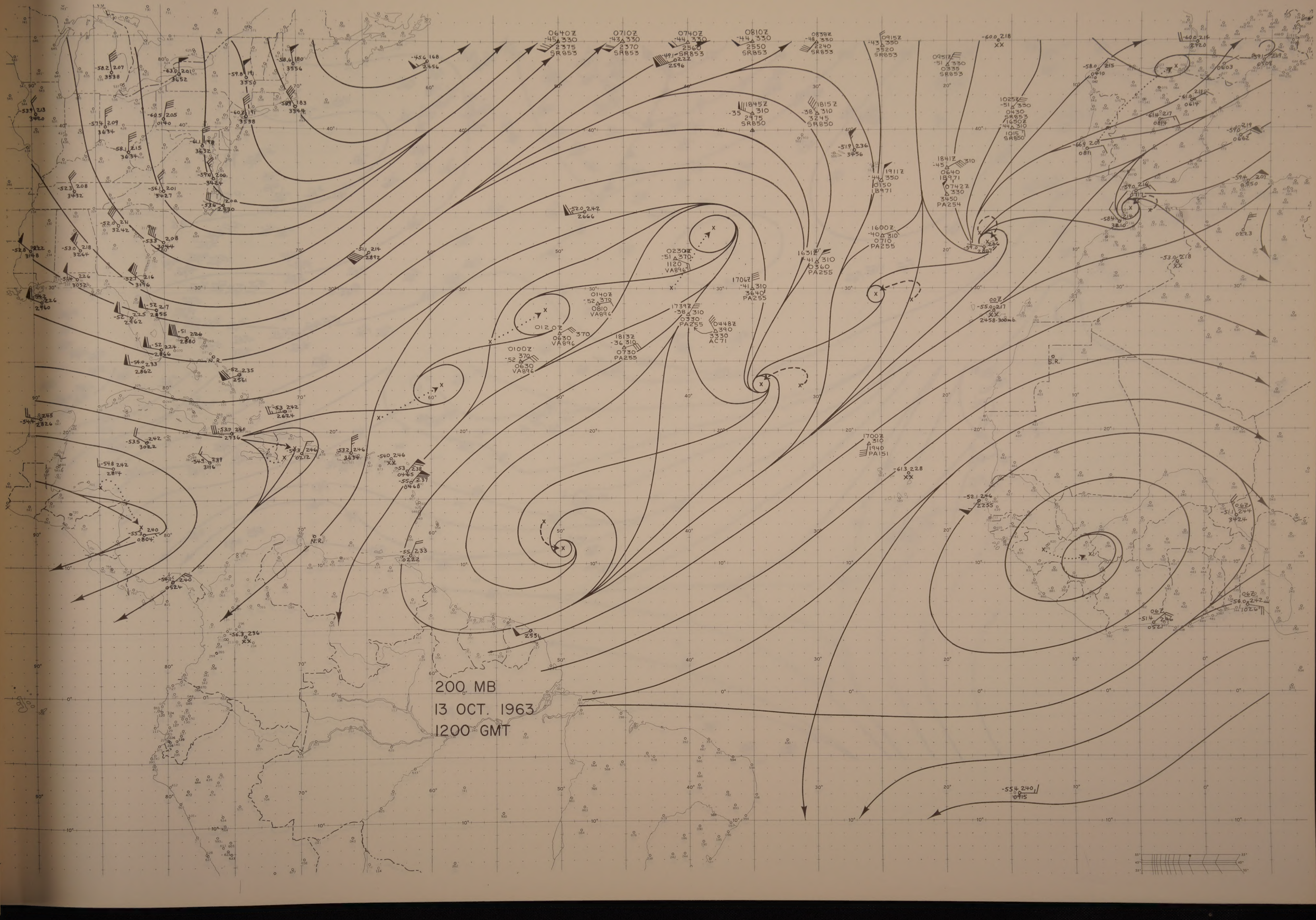
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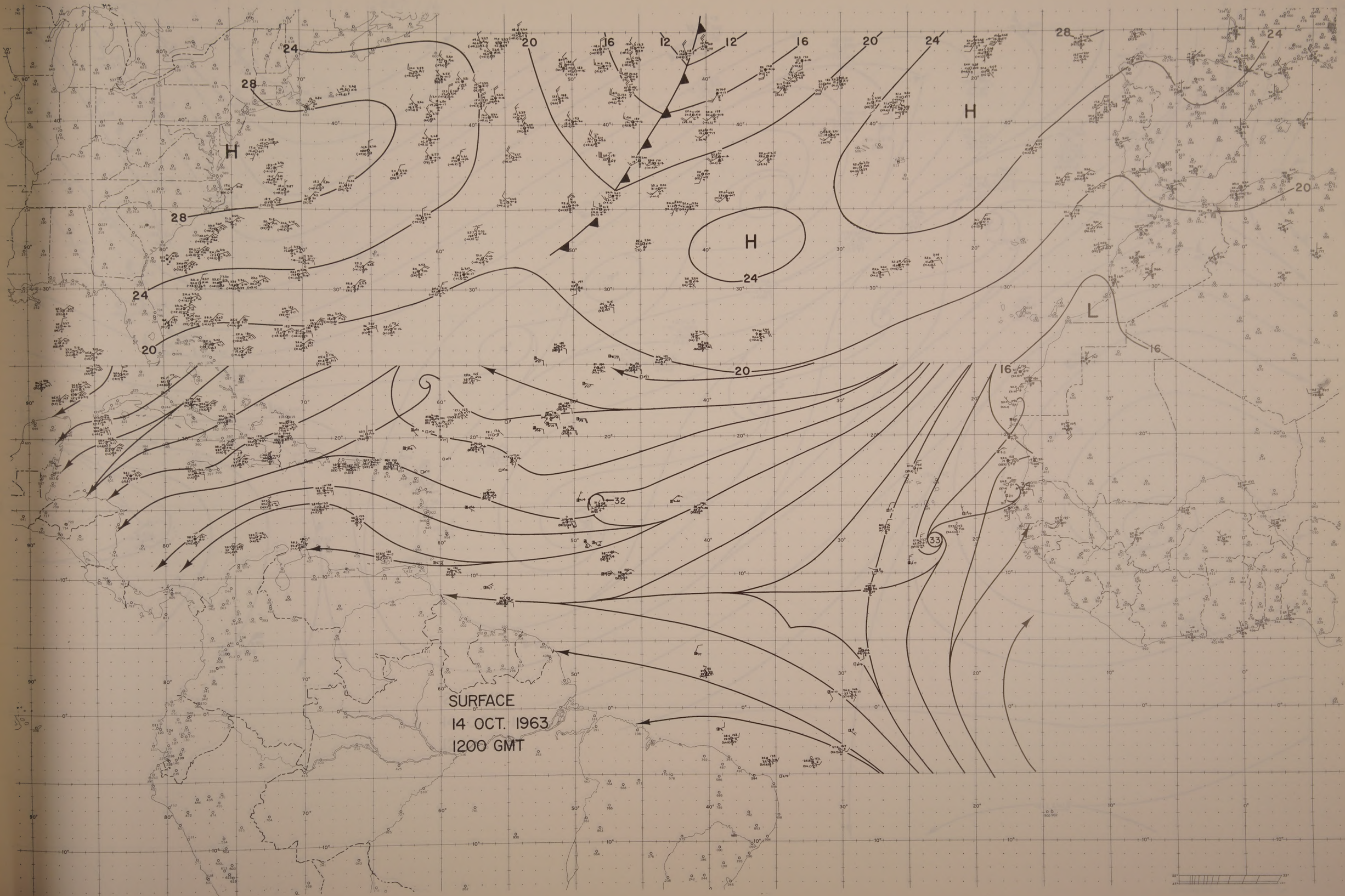
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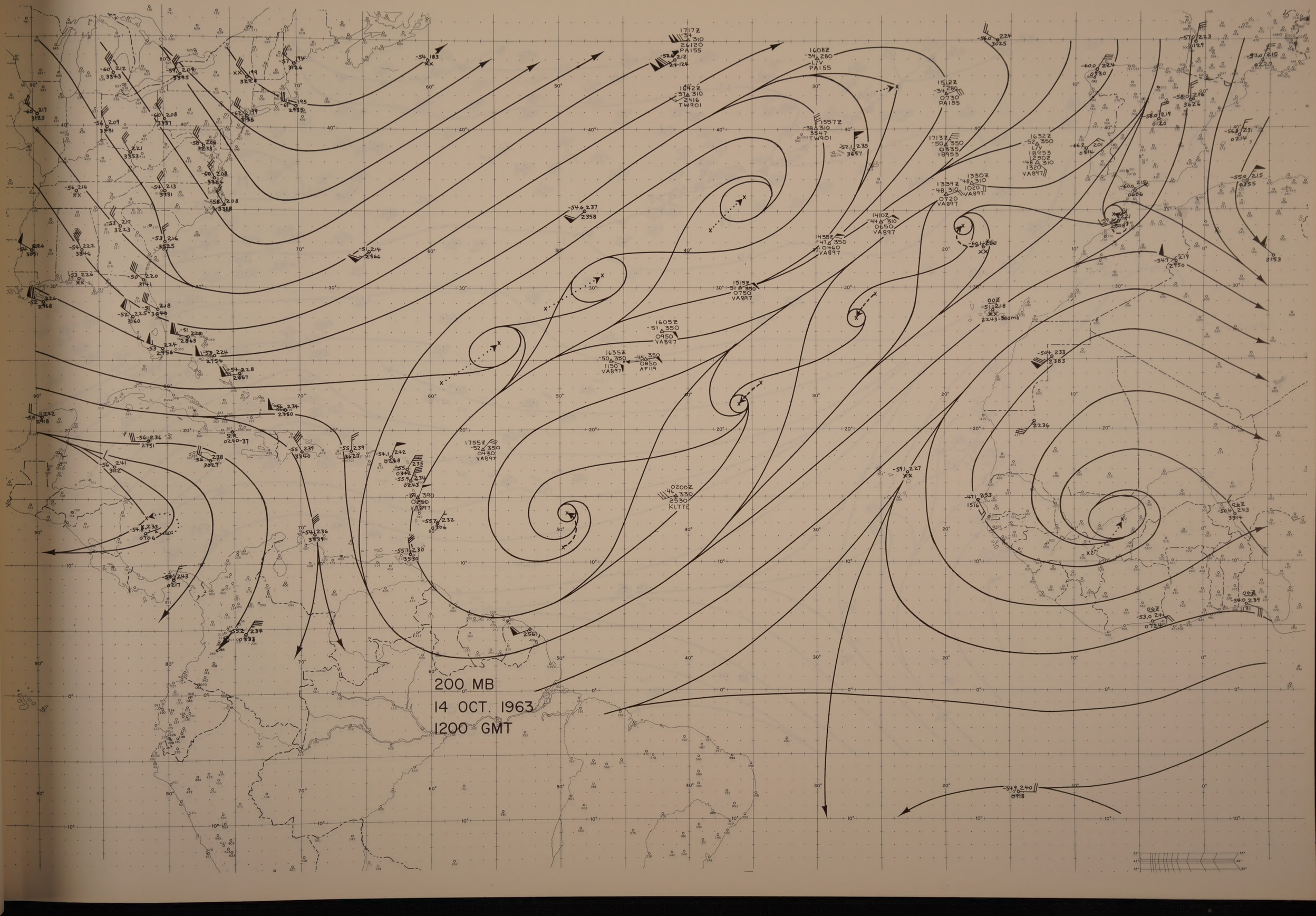
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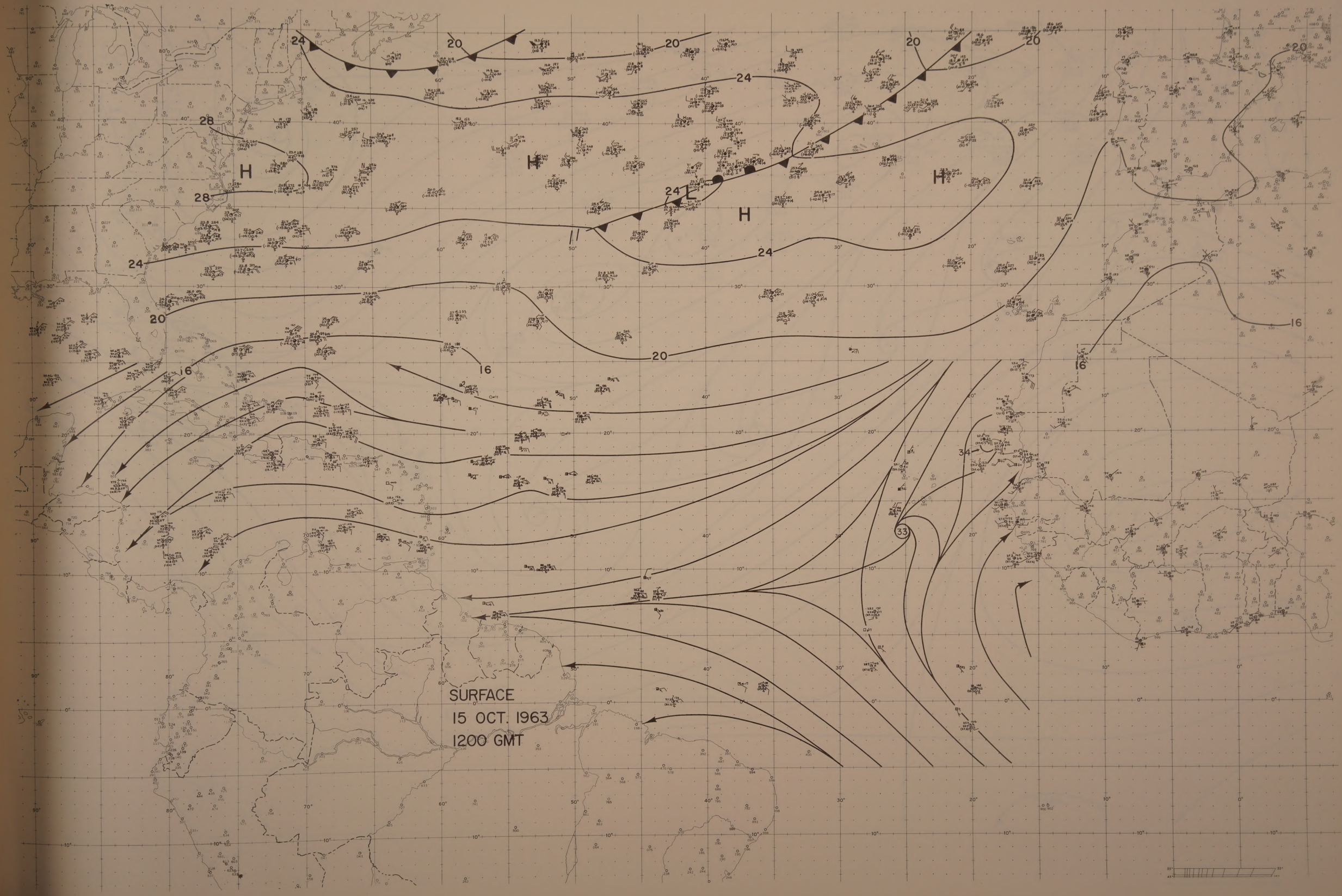
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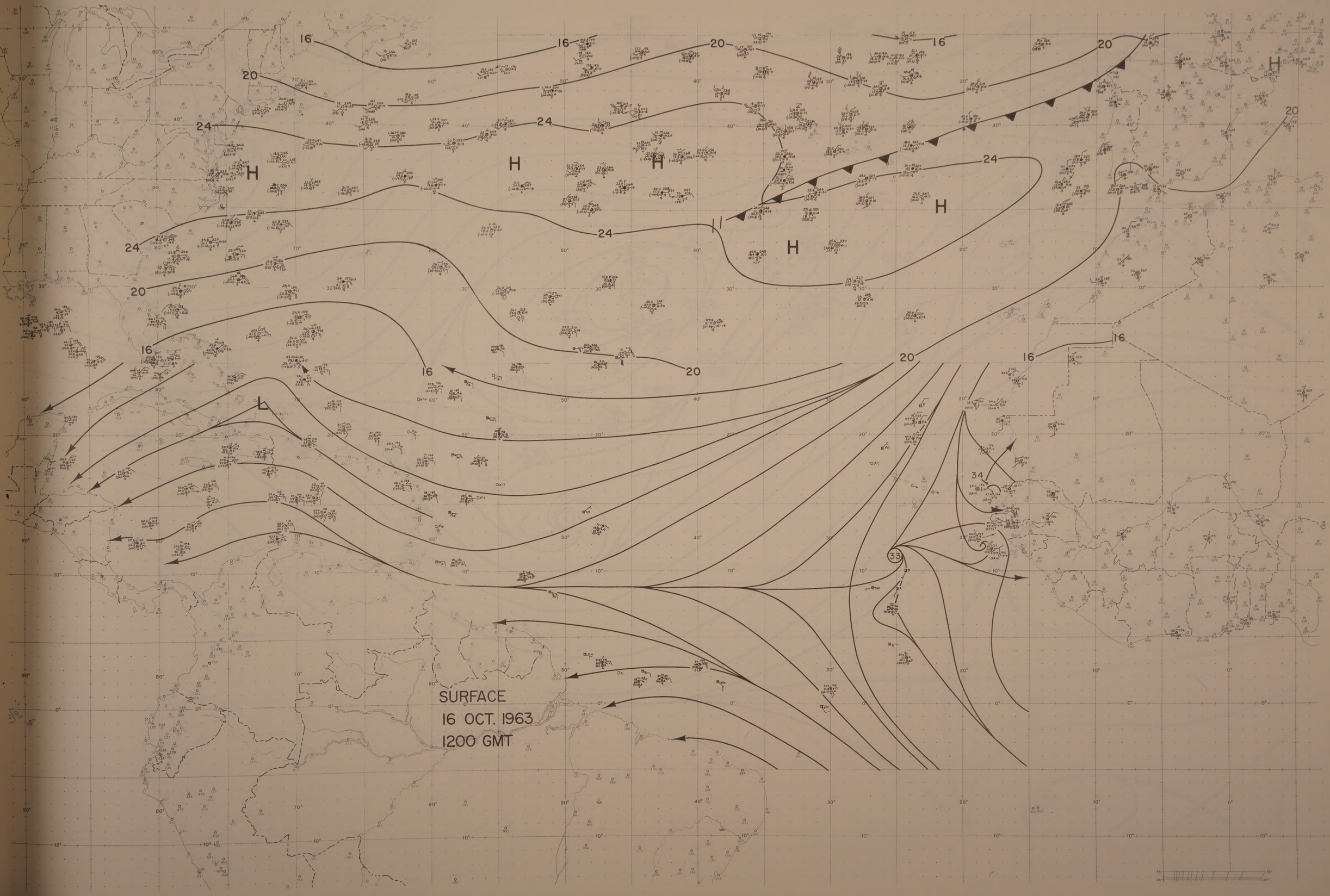
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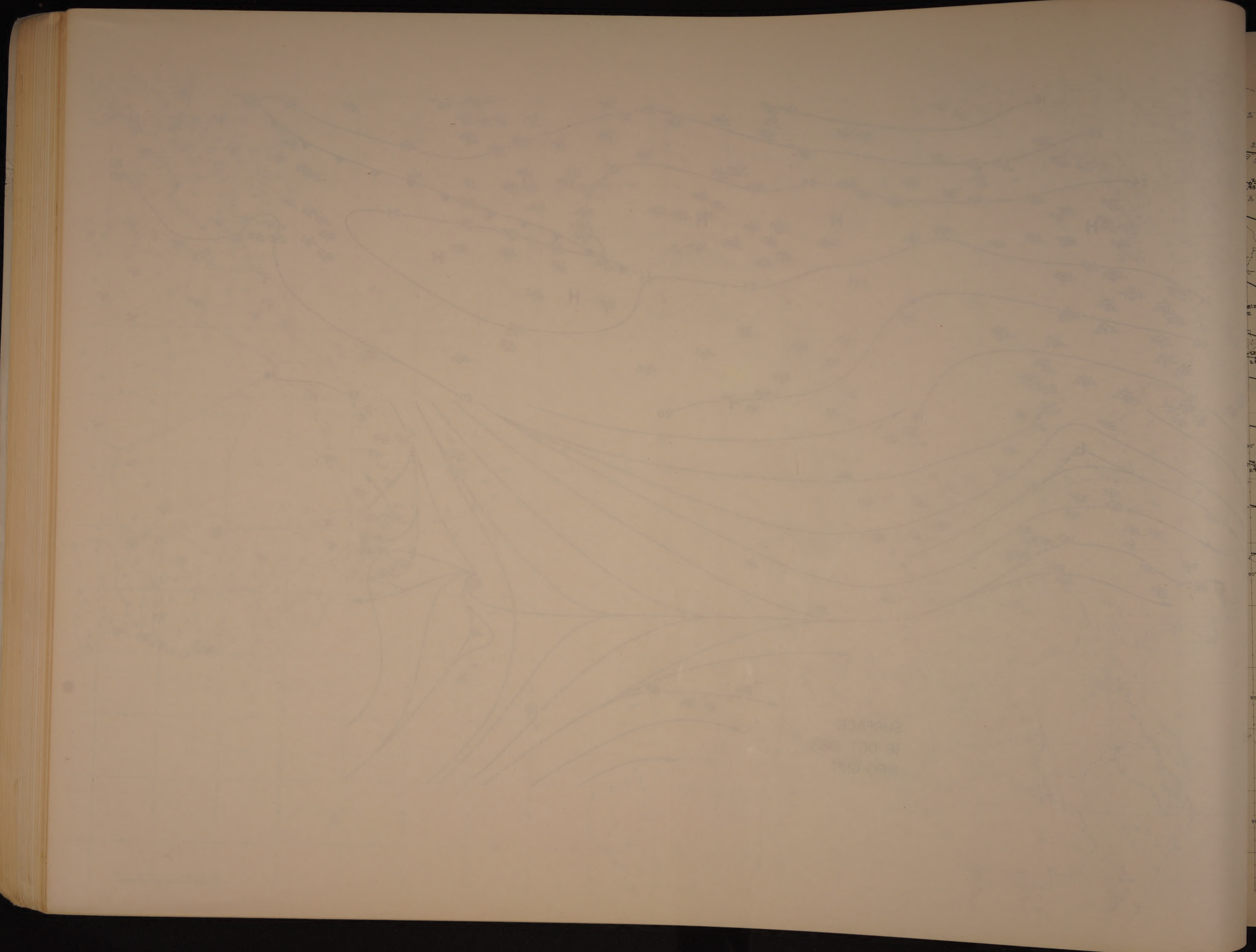

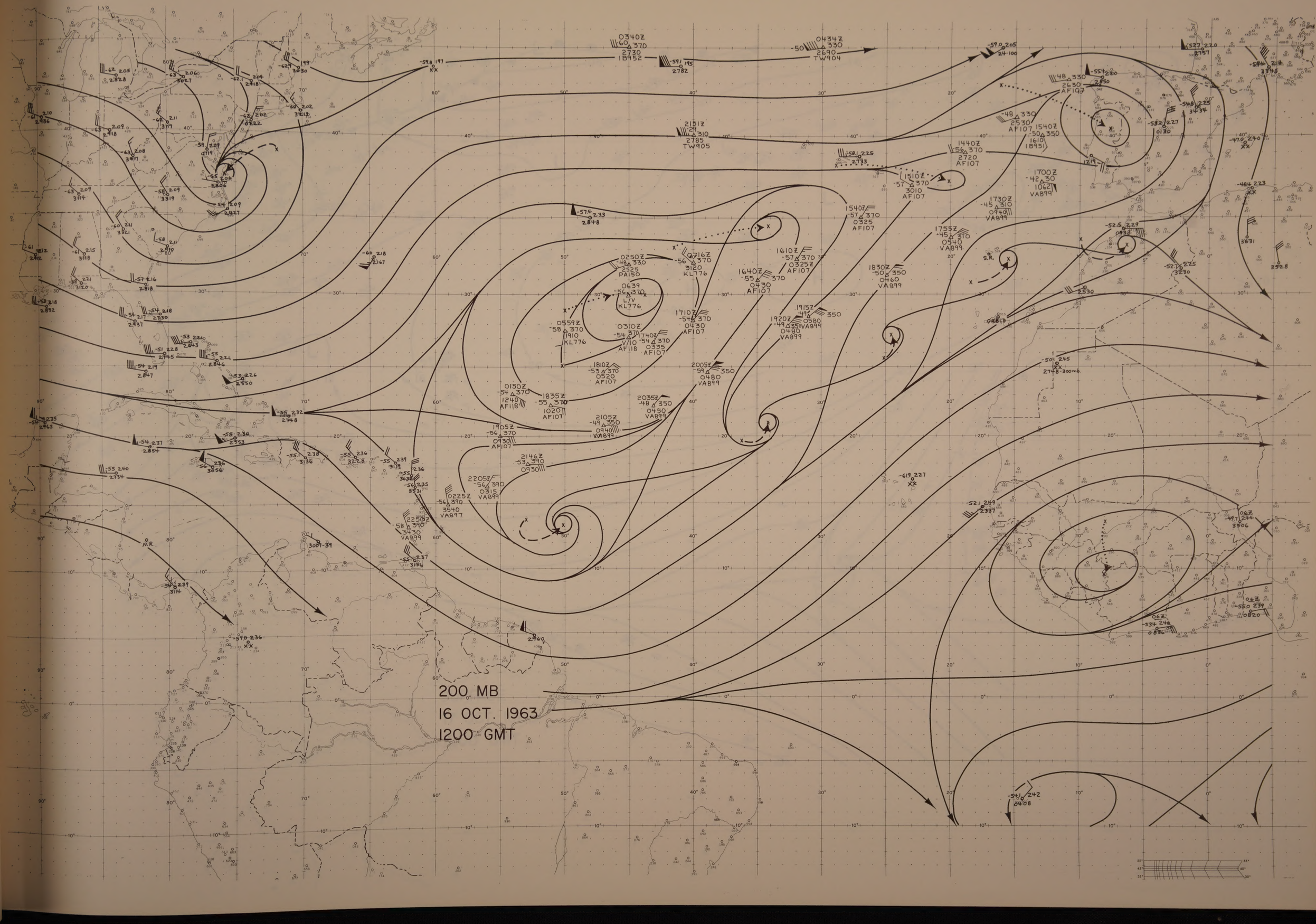
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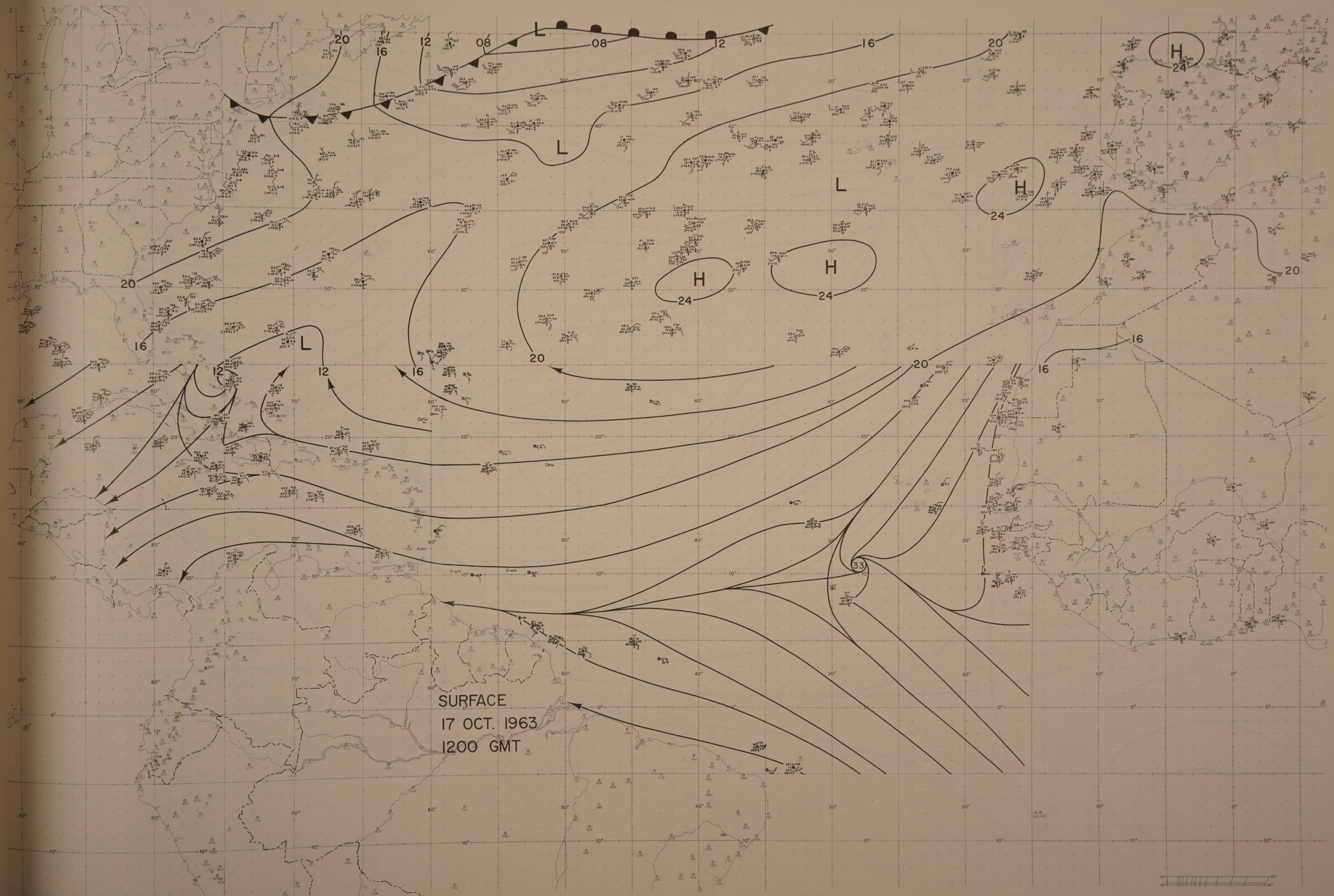
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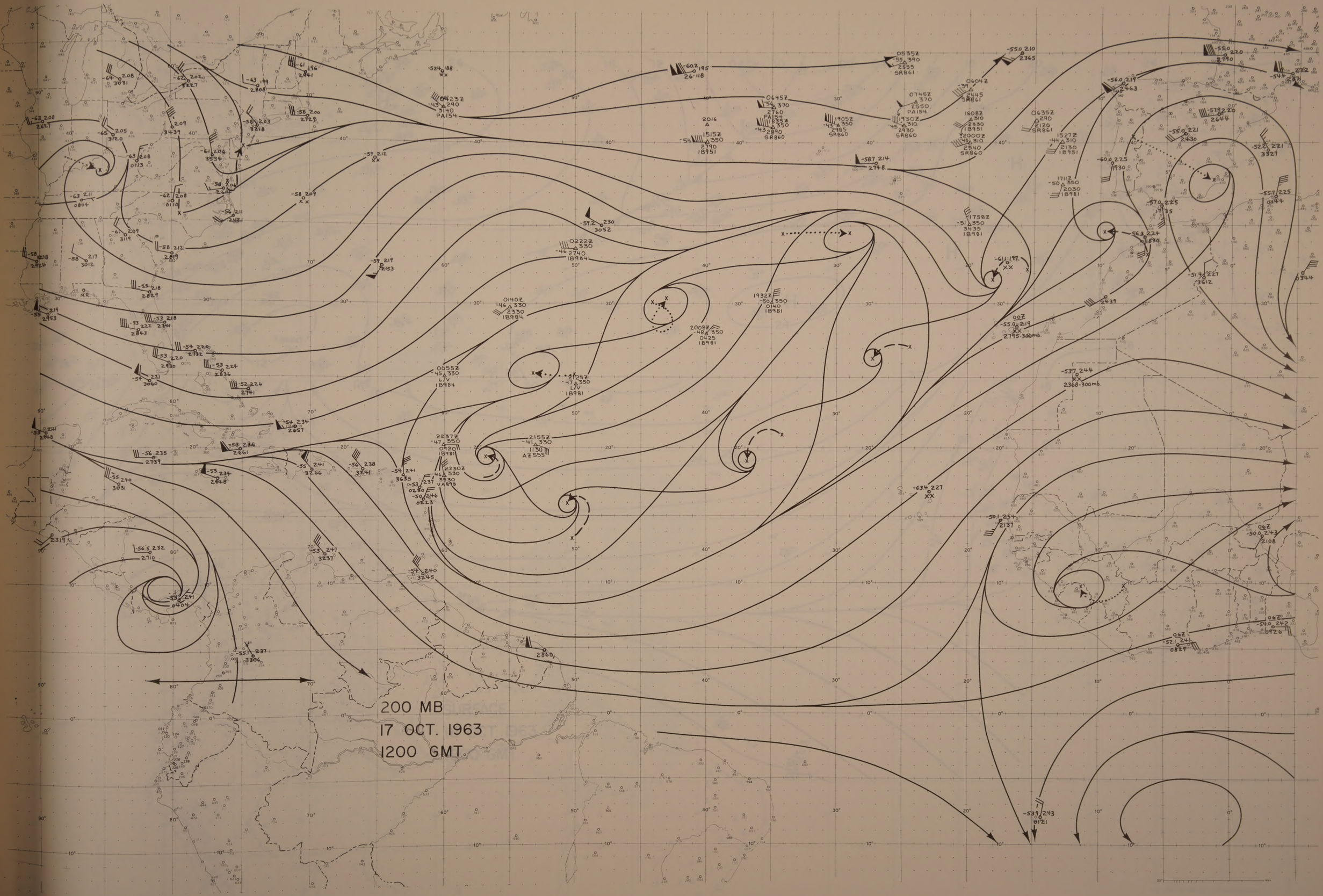
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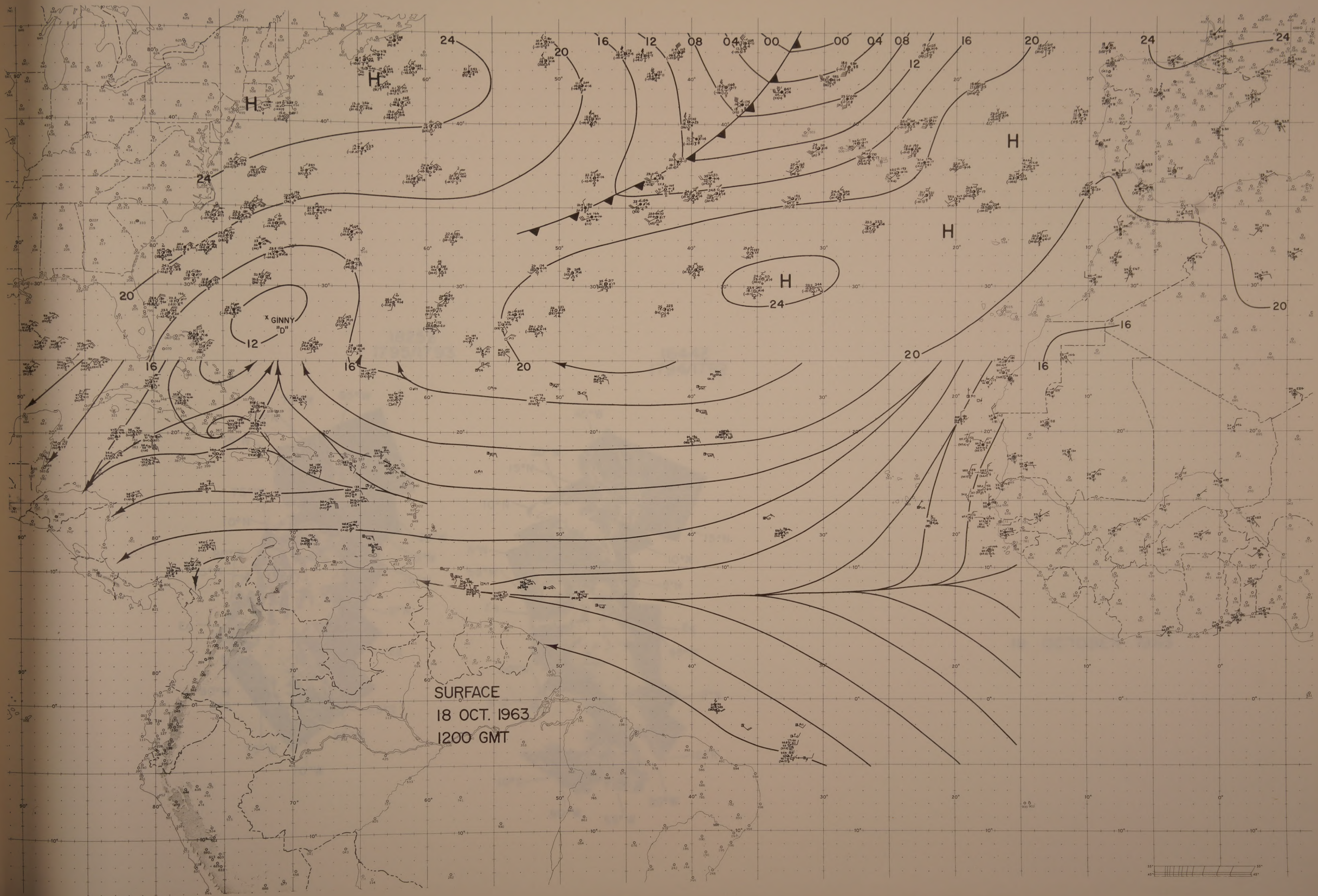
17 OCT 1983
1500 GMT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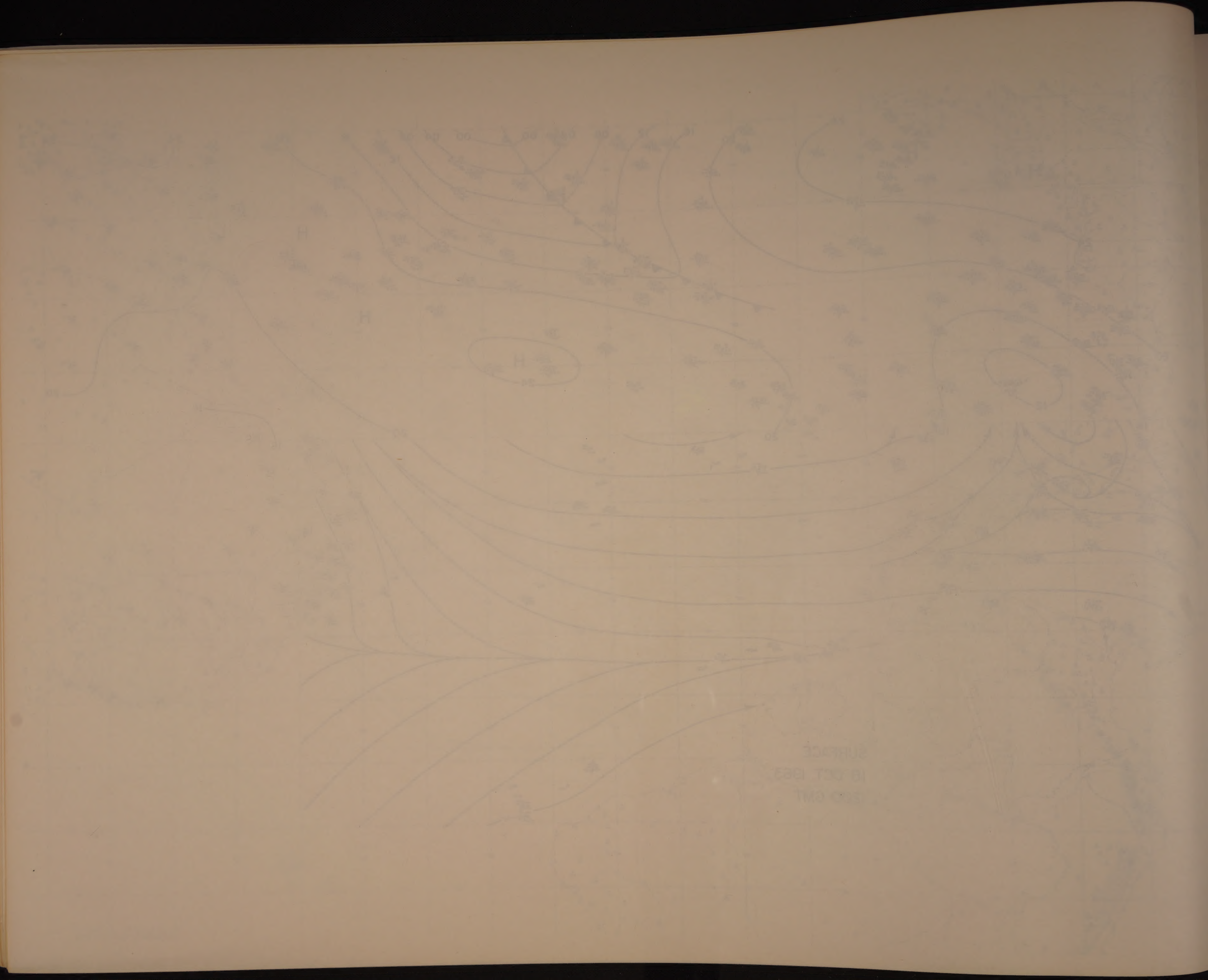
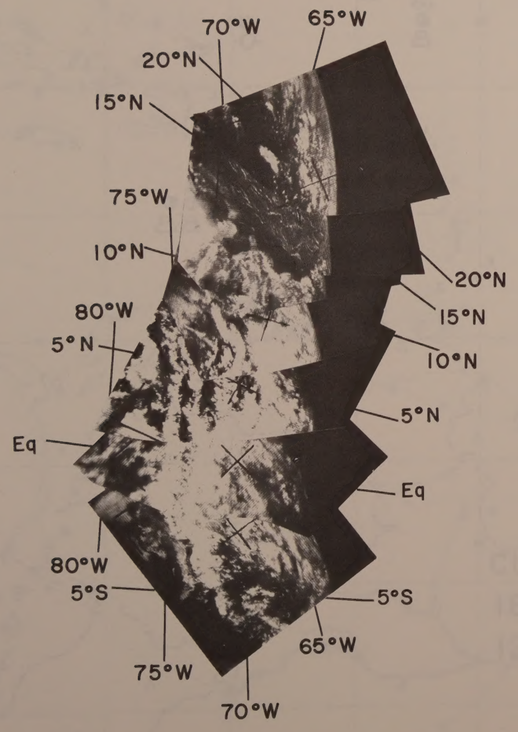
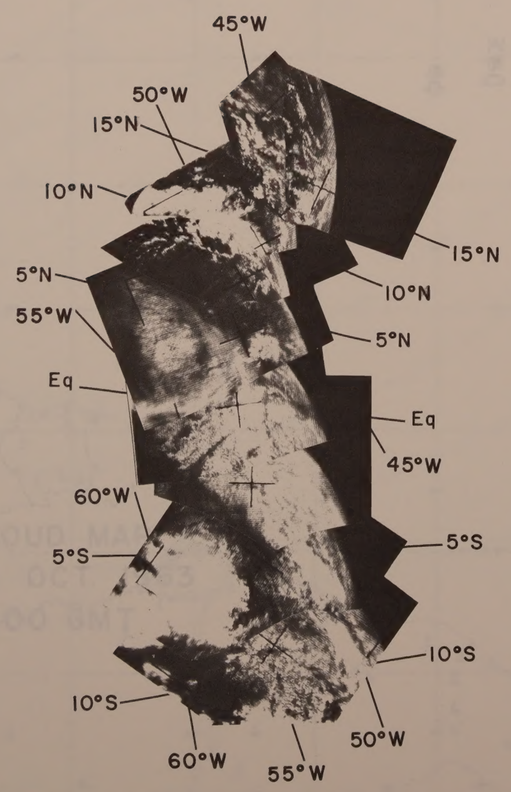
"D"
SURFACE
18 OCT. 1963
1200 GMT



1825Z
1795/1793



1644Z
1794/1792



18 OCTOBER 1963

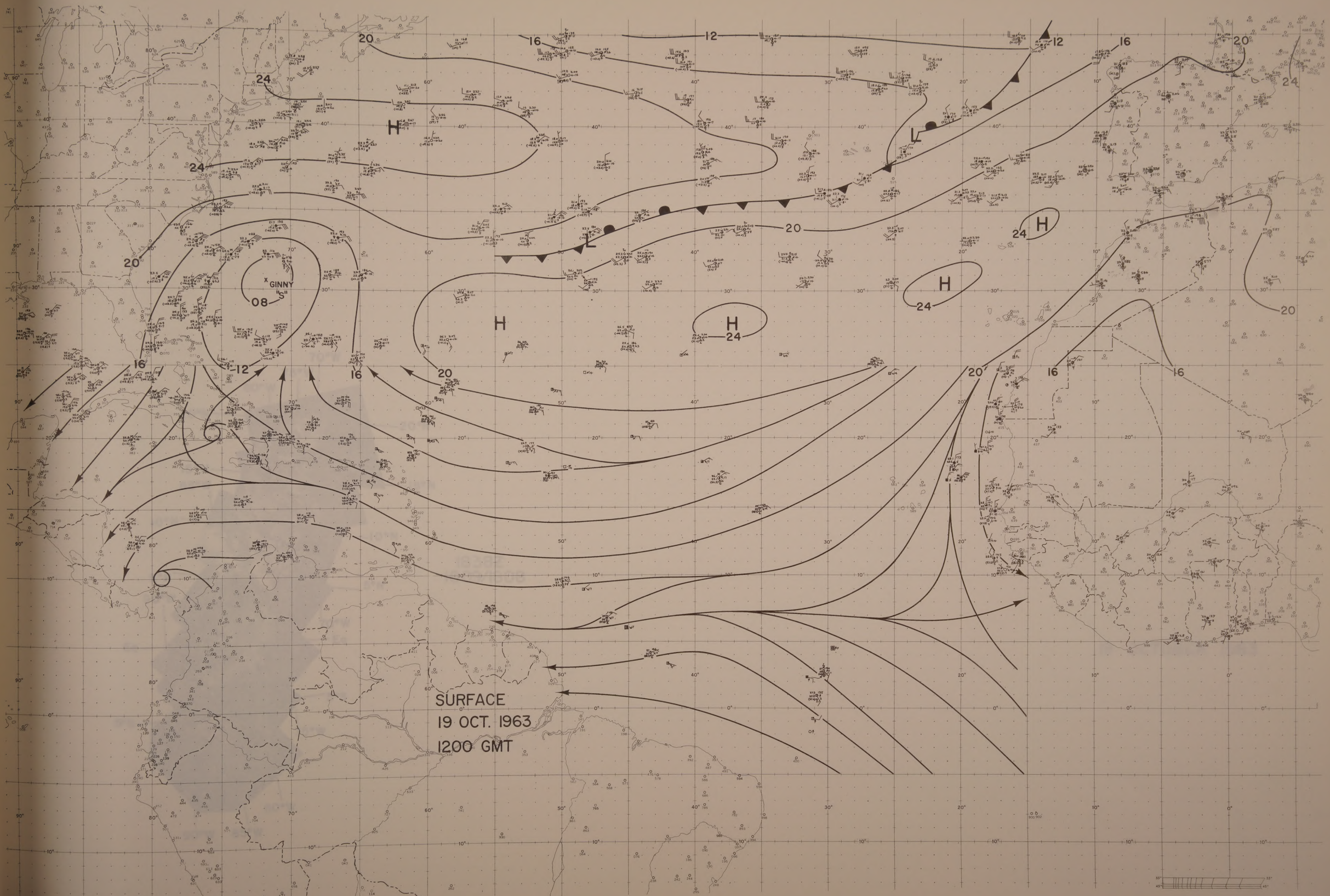
CLOUD MAP
18 OCT. 1963
1200 GMT

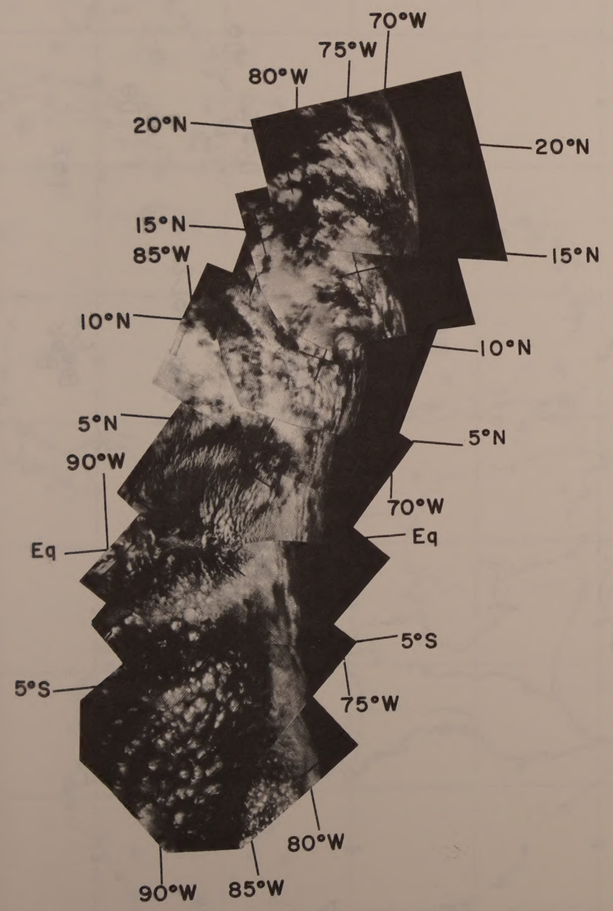
GINNY
x "D"

N.R.

N.R.

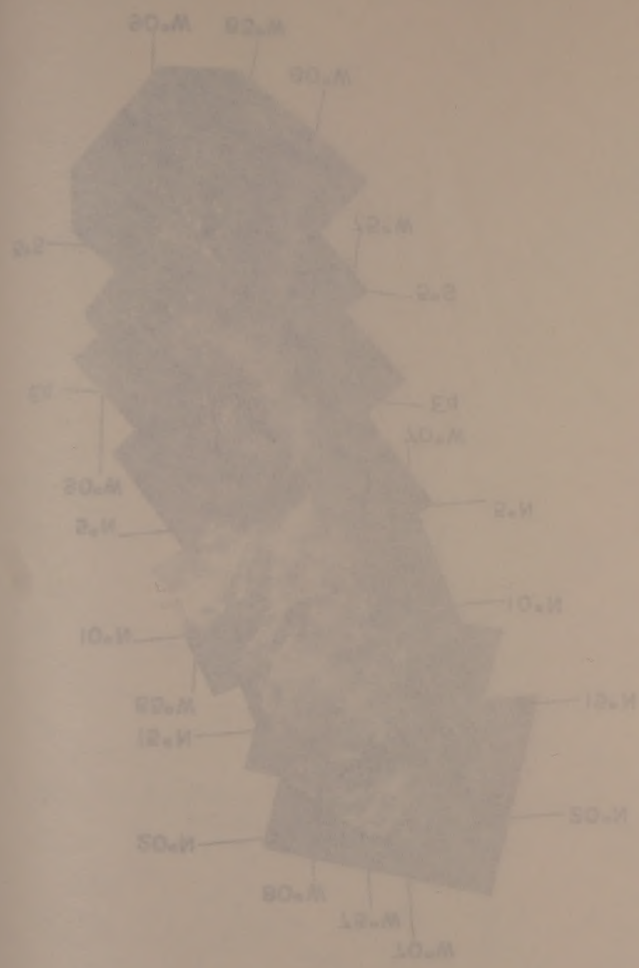
200 MB
18 OCT. 1963
1200 GMT


GINNY
08
SURFACE
19 OCT. 1963
1200 GMT

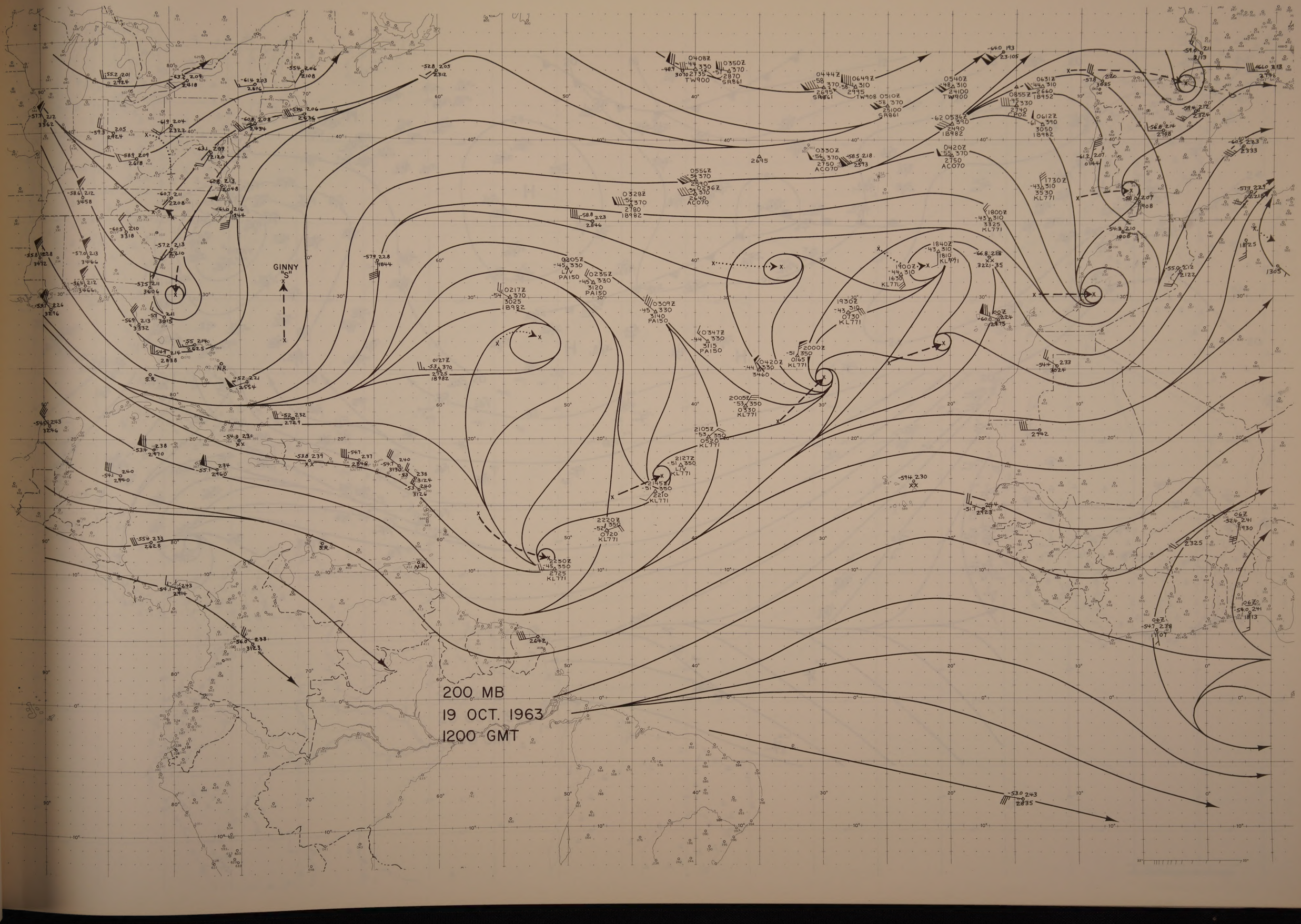


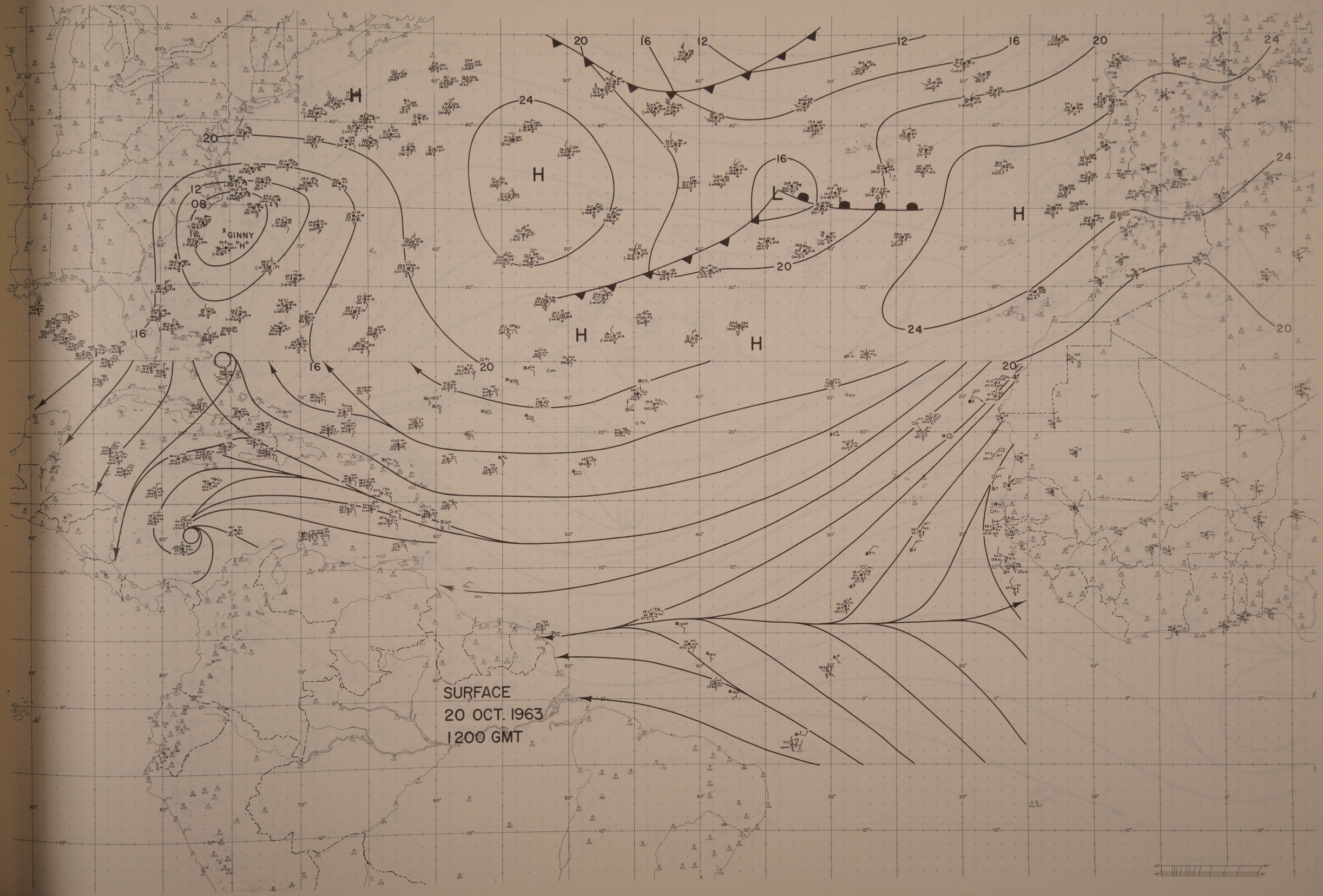
1838Z
1809/1808

19 OCTOBER 1963



CLOUD MAP
19 OCT. 1963
1200 GMT


GINNY
"S"
S.R.
N.R.
0408Z
0350Z
0444Z
0649Z
0540Z
0631Z
0855Z
0612Z
0510Z
0330Z
0420Z
0556Z
0236Z
0328Z
1730Z
1800Z
1840Z
1900Z
1930Z
0205Z
0235Z
0217Z
0309Z
0347Z
0127Z
2000Z
0420Z
2005Z
2105Z
2127Z
2145Z
2220Z
2230Z
200 MB
19 OCT. 1963
1200 GMT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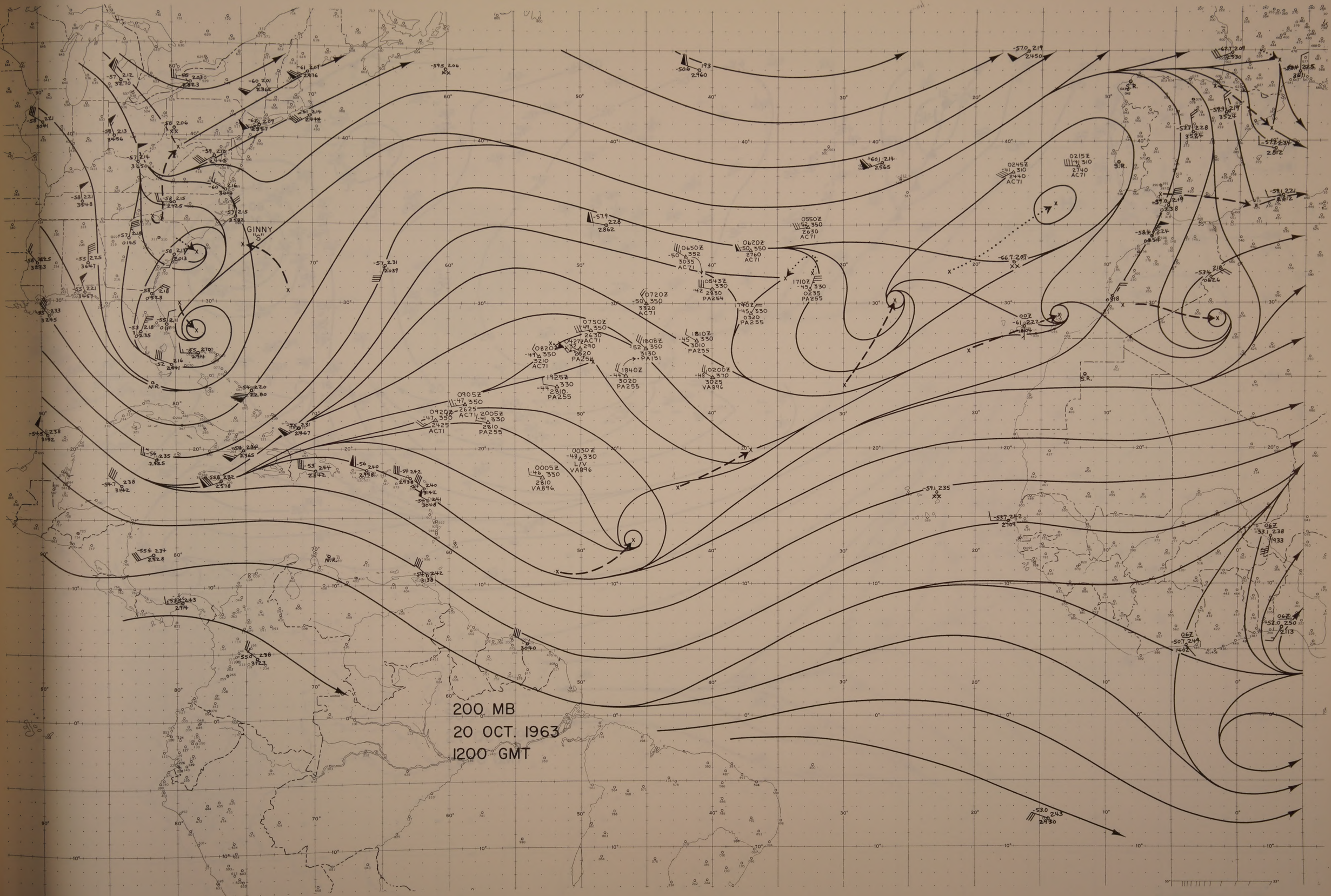
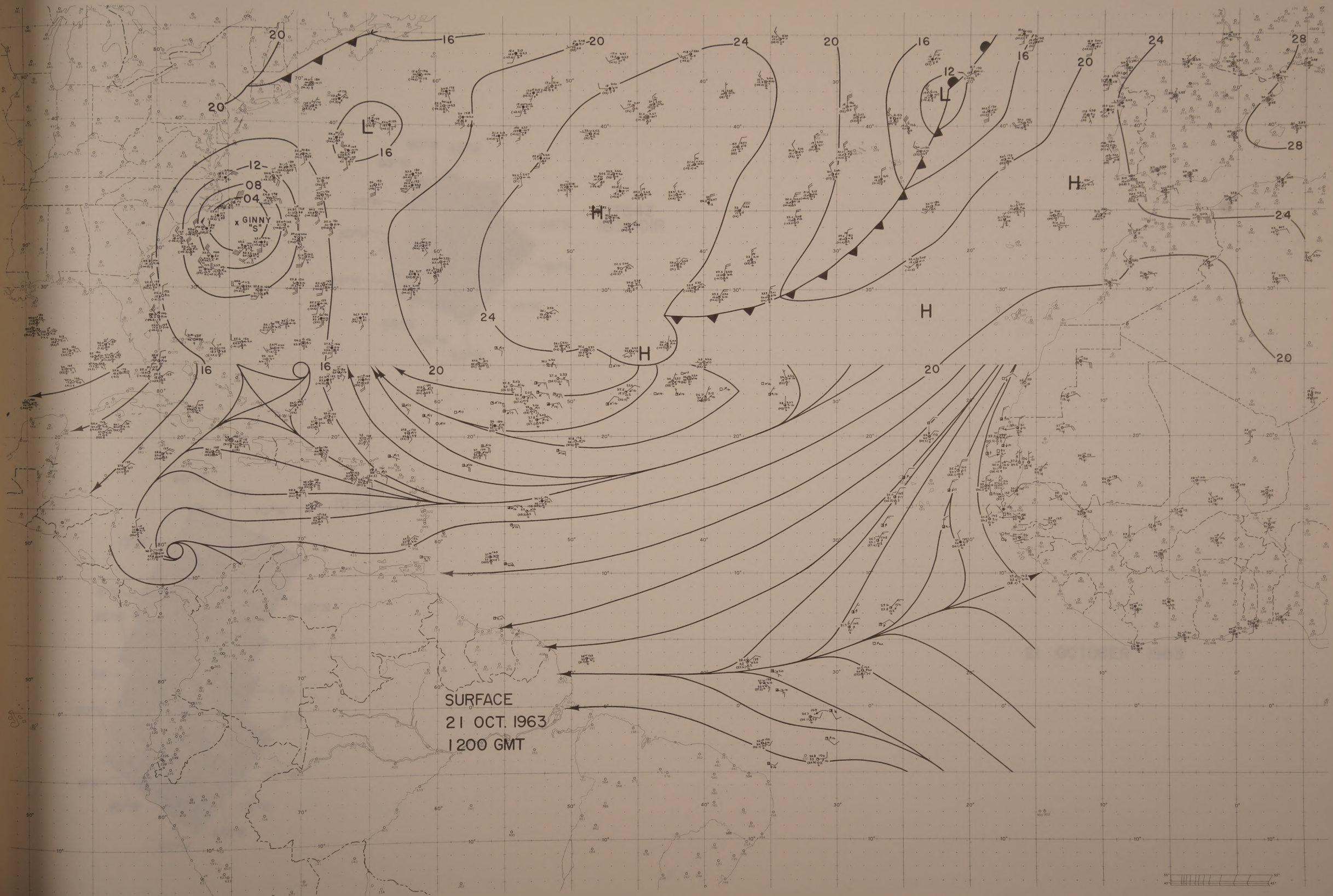
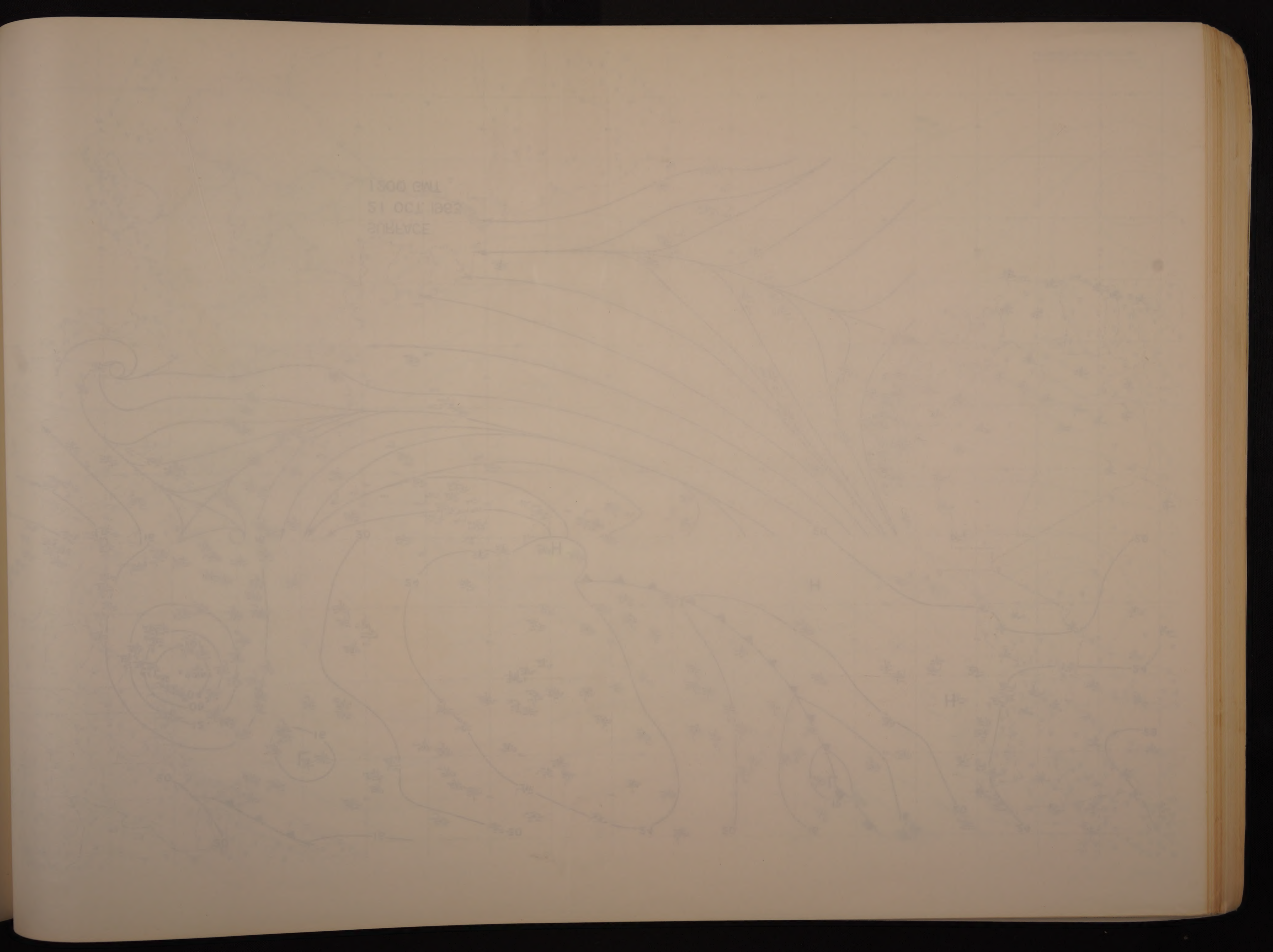
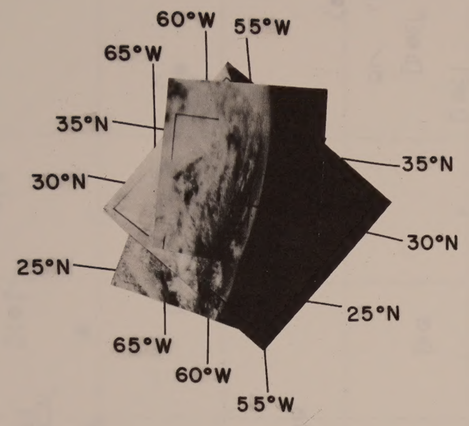
GINNY
"H"
SURFACE
20 OCT. 1963
1200 GMT


GINNY
"S"
200 MB
20 OCT. 1963
1200 GMT

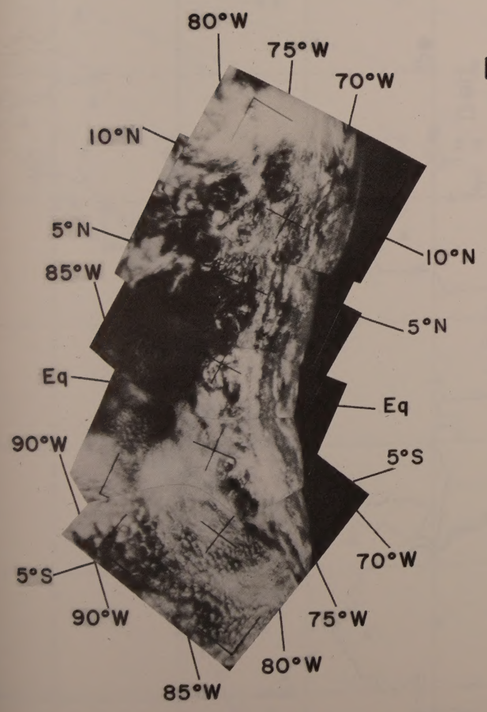
200 MB
20 OCT 1953
1200 GMT


GINNY
"S"
SURFACE
21 OCT. 1963
1200 GMT





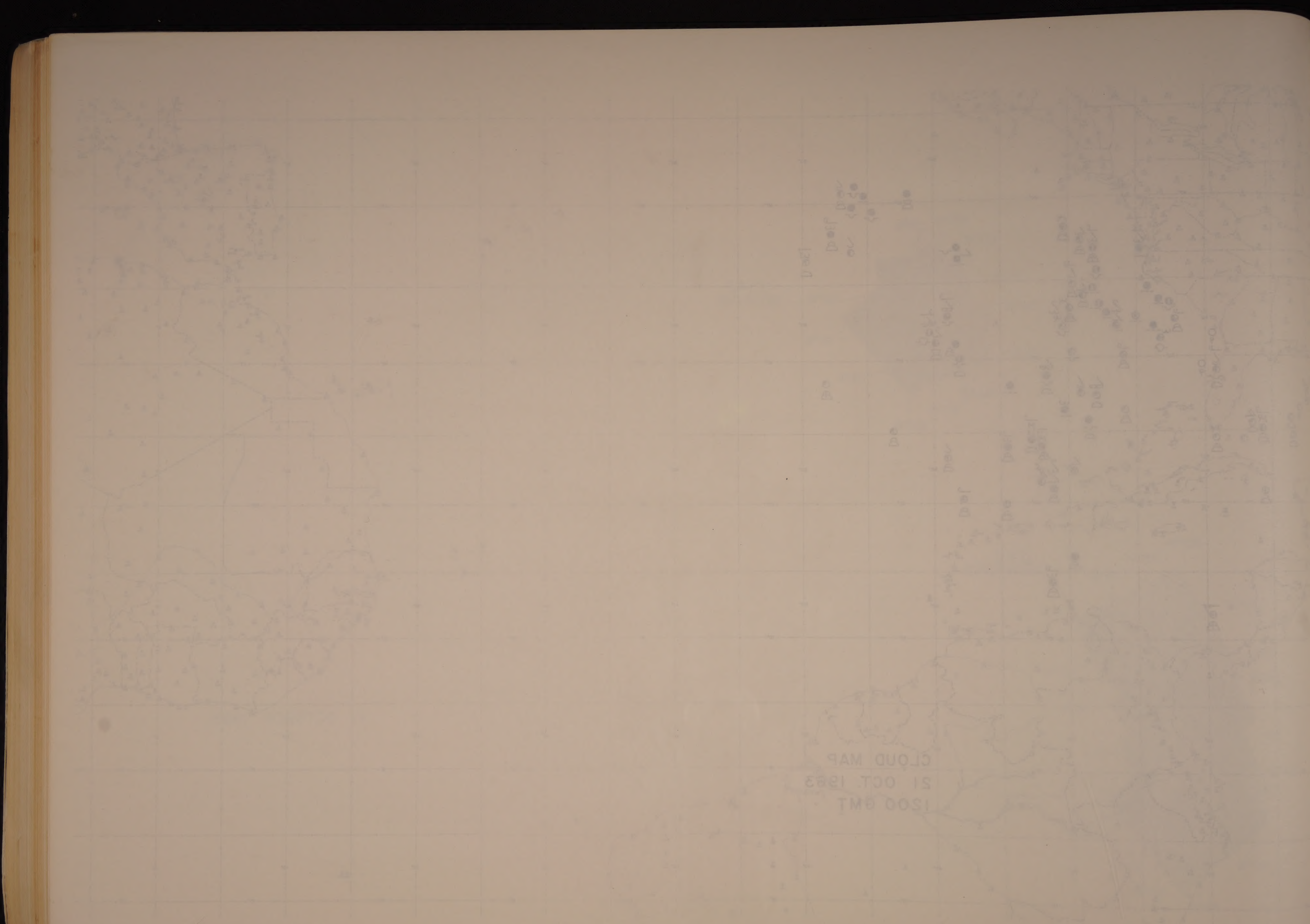
1754Z
1838 DIR

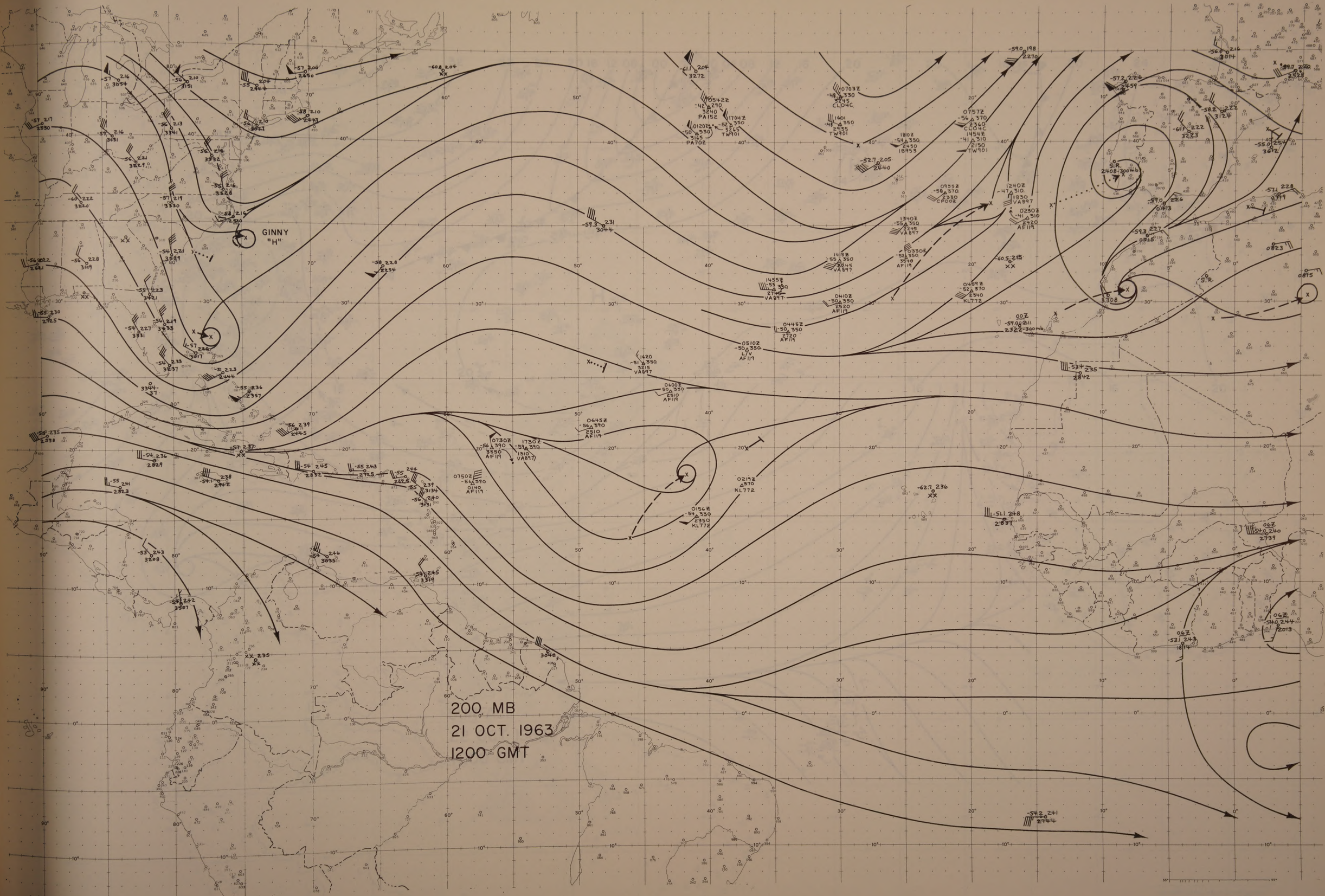


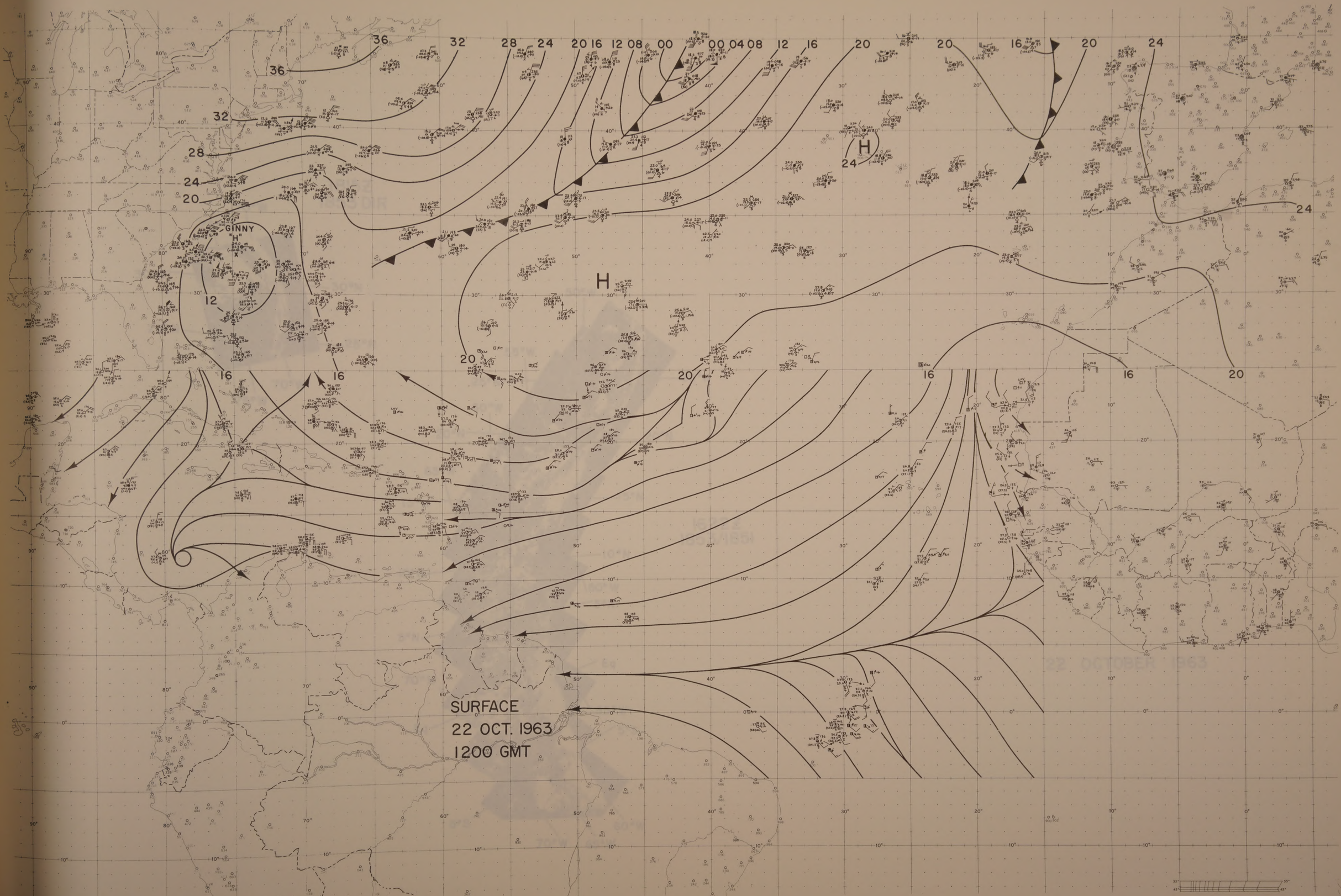
1741Z
1838/1837

21 OCTOBER 1963

CLOUD MAP
21 OCT. 1963
1200 GMT


CLOUD MAP
21 OCT 1983
1200 GMT


GINNY
"H"
200 MB
21 OCT. 1963
1200 GMT


GINNY
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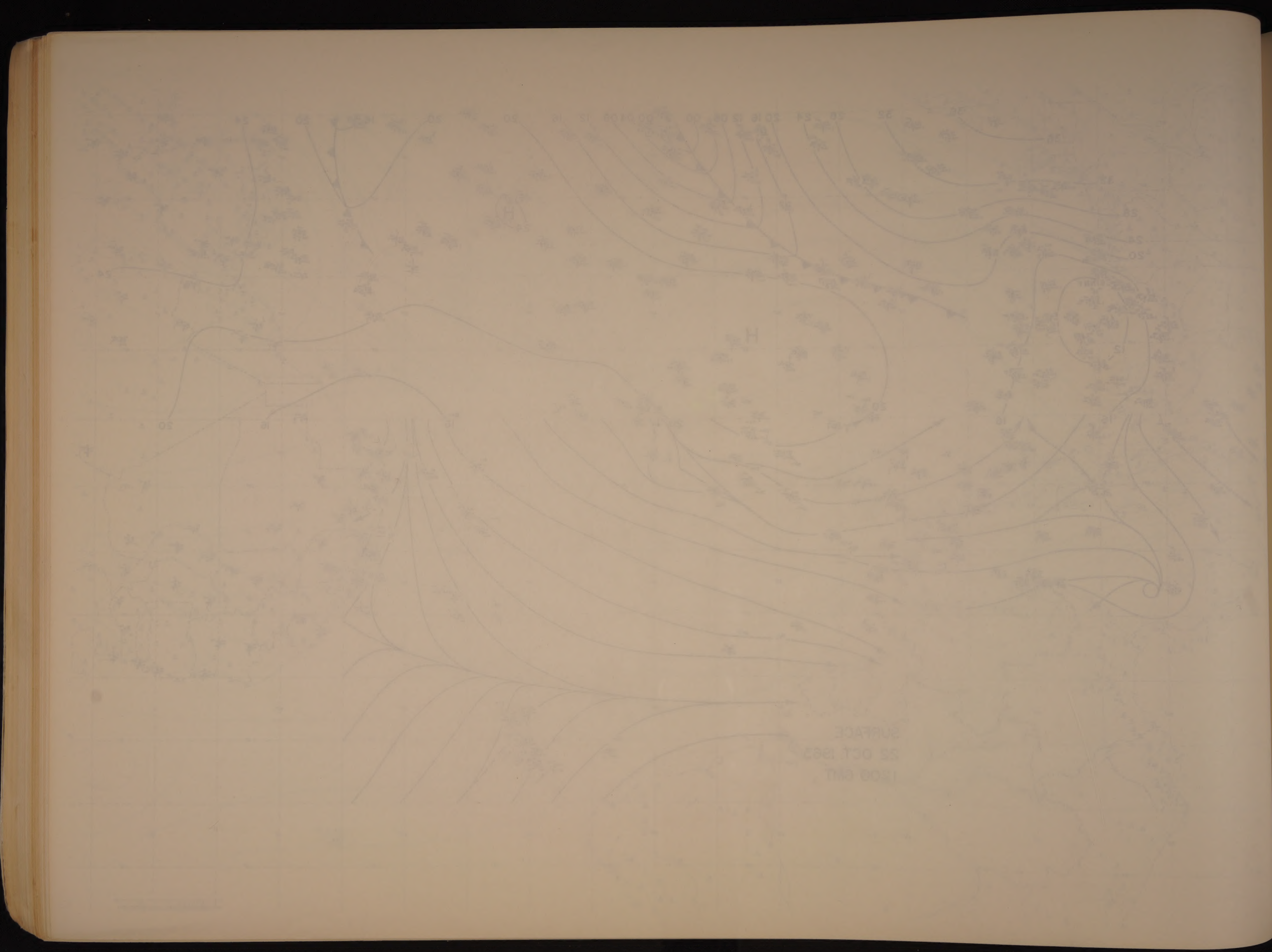
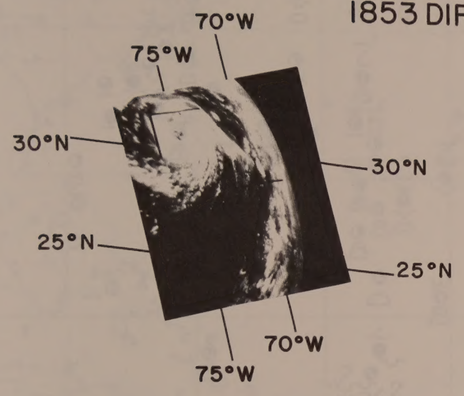
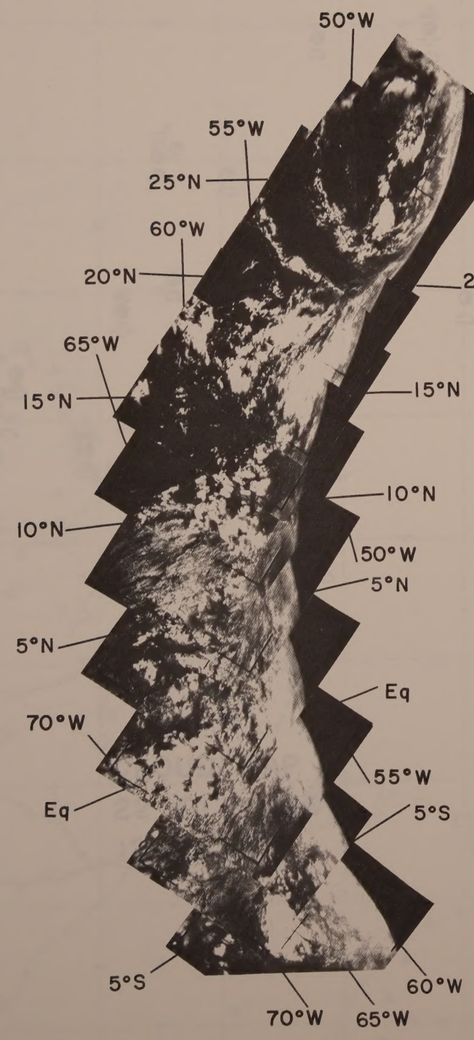
22 OCT. 1963
1200 GMT



1815Z
1853 DIR





1622Z
1853/1851

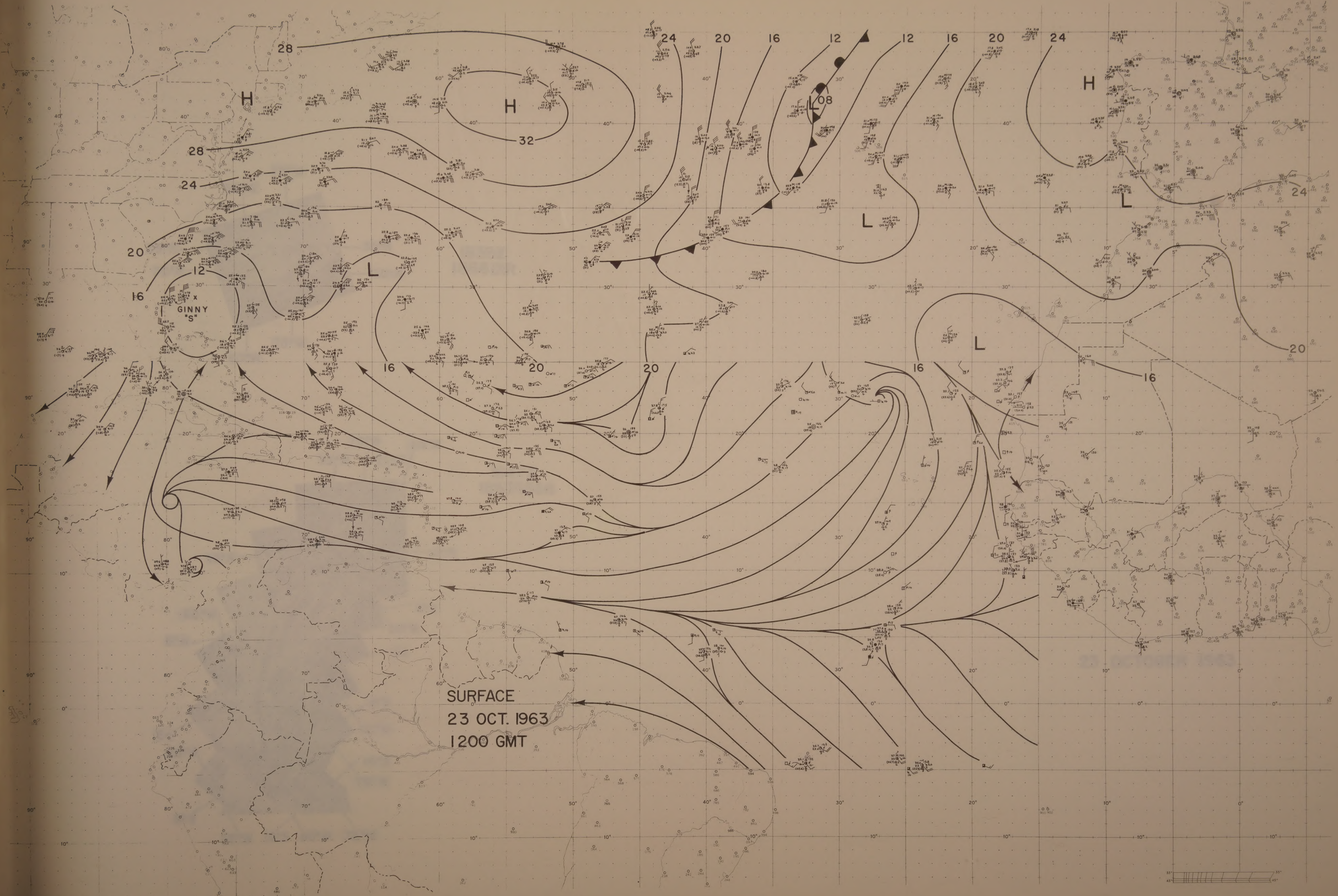
22 OCTOBER 1963

CLOUD MAP
22 OCT. 1963
1200 GMT

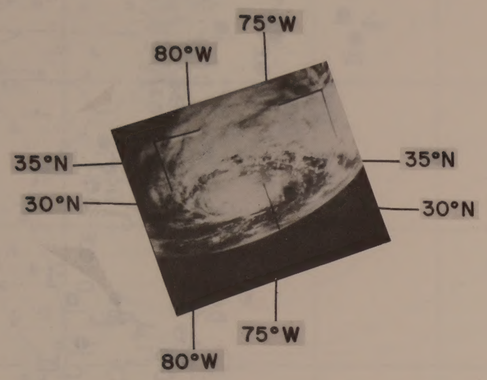
CLOUD MAP
22 OCT. 1953
1200 GMT

GINNY "H"

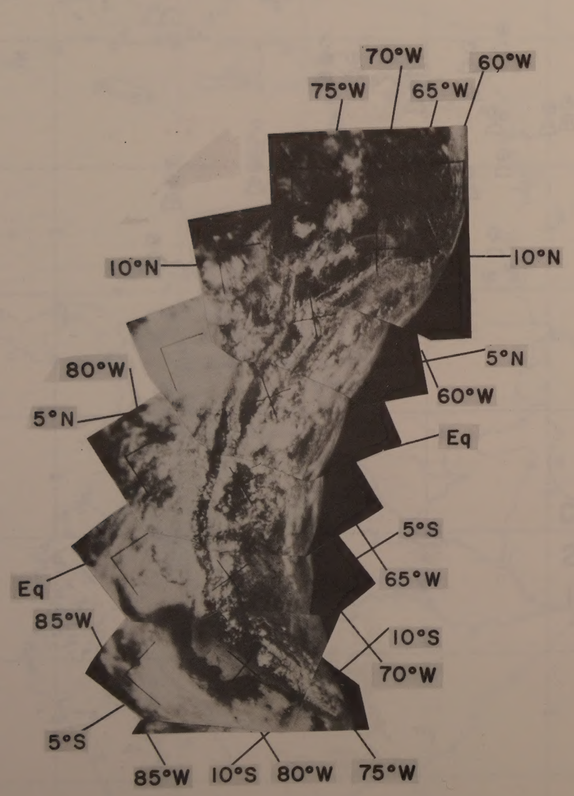
200 MB
22 OCT. 1963
1200 GMT



SURFACE
23 OCT. 1963
1200 GMT

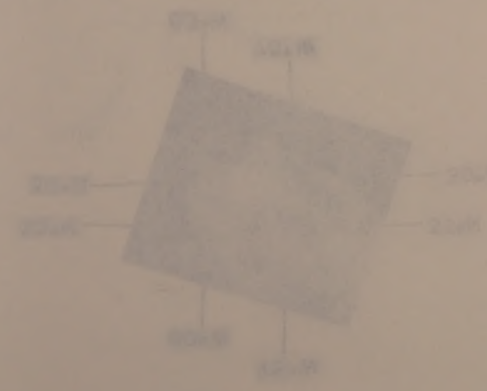


1838Z
1868DIR



1647Z
1867/1866

23 OCTOBER 1963

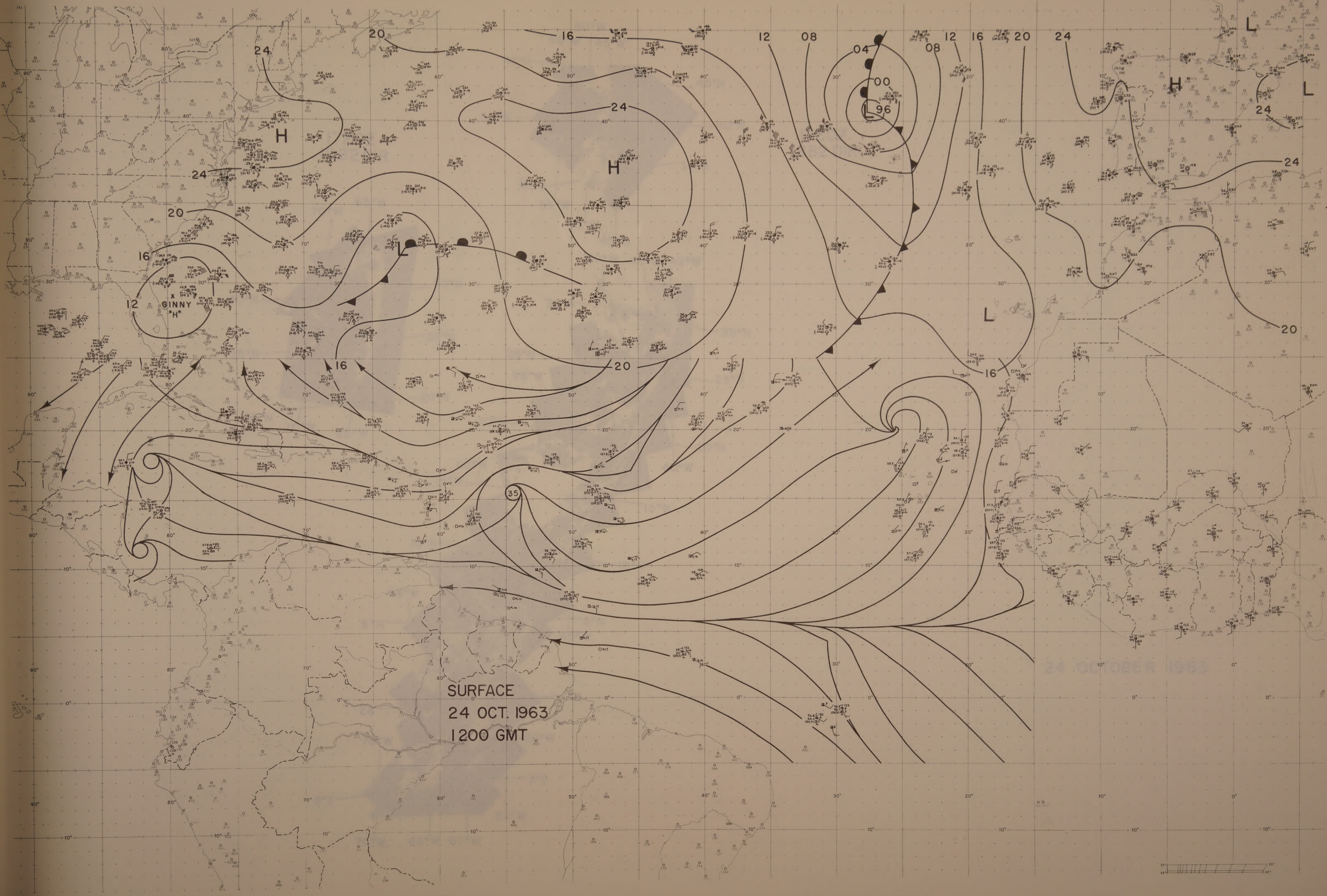


CLOUD MAP
23 OCT. 1963
1200 GMT

CLOUD MAP
25 OCT 1963
1500 GMT

GINNY "S"

200 MB
23 OCT. 1963
1200 GMT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SURFACE
24 OCT. 1963
1200 GMT

1720Z
1882 DIR

1720Z
1882 DIR

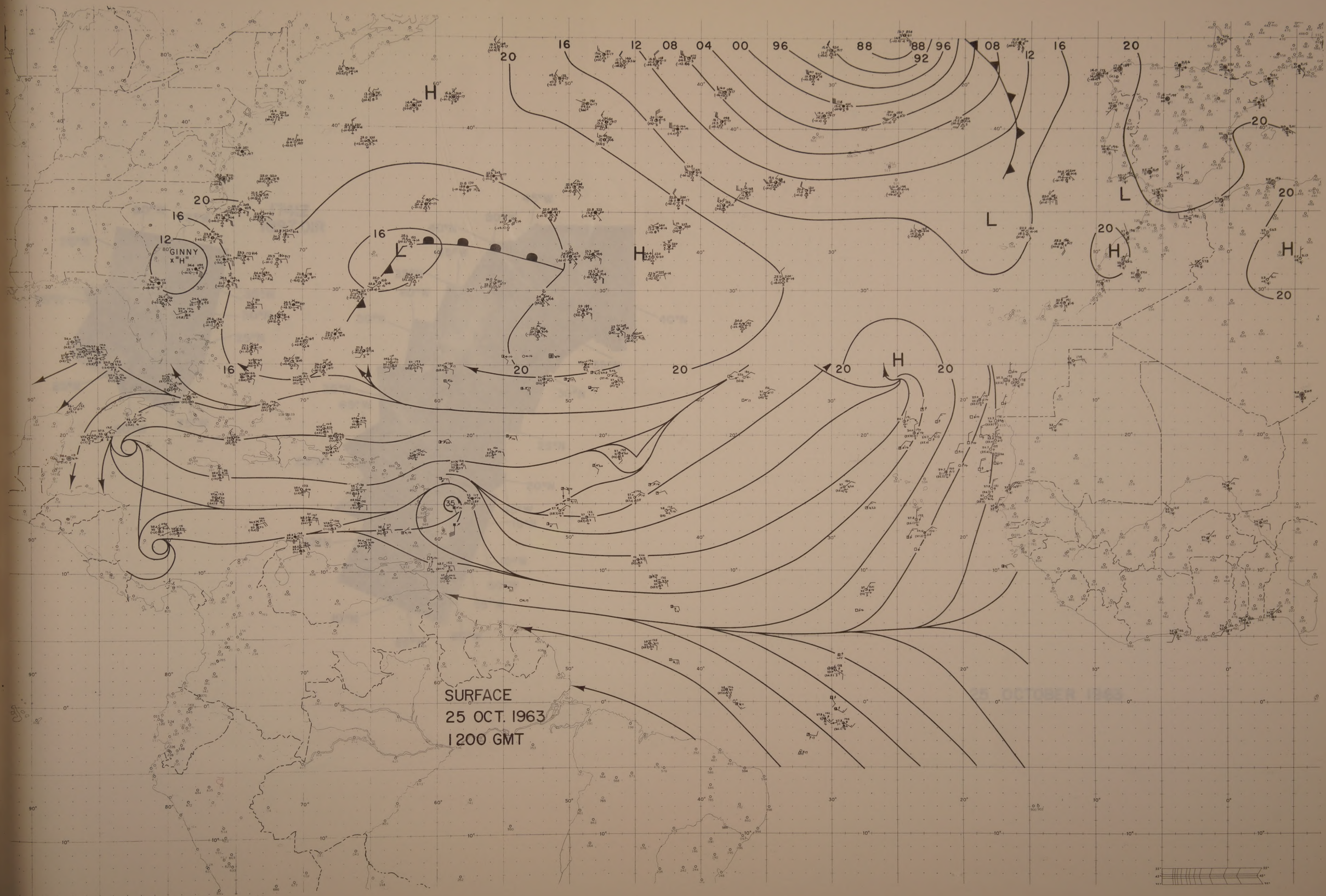
24 OCTOBER 1963

CLOUD MAP
24 OCT. 1963
1200 GMT

CLOUD MAP
24 OCT 1963
1500 GMT

GINNY
"H"

200 MB
24 OCT. 1963
1200 GMT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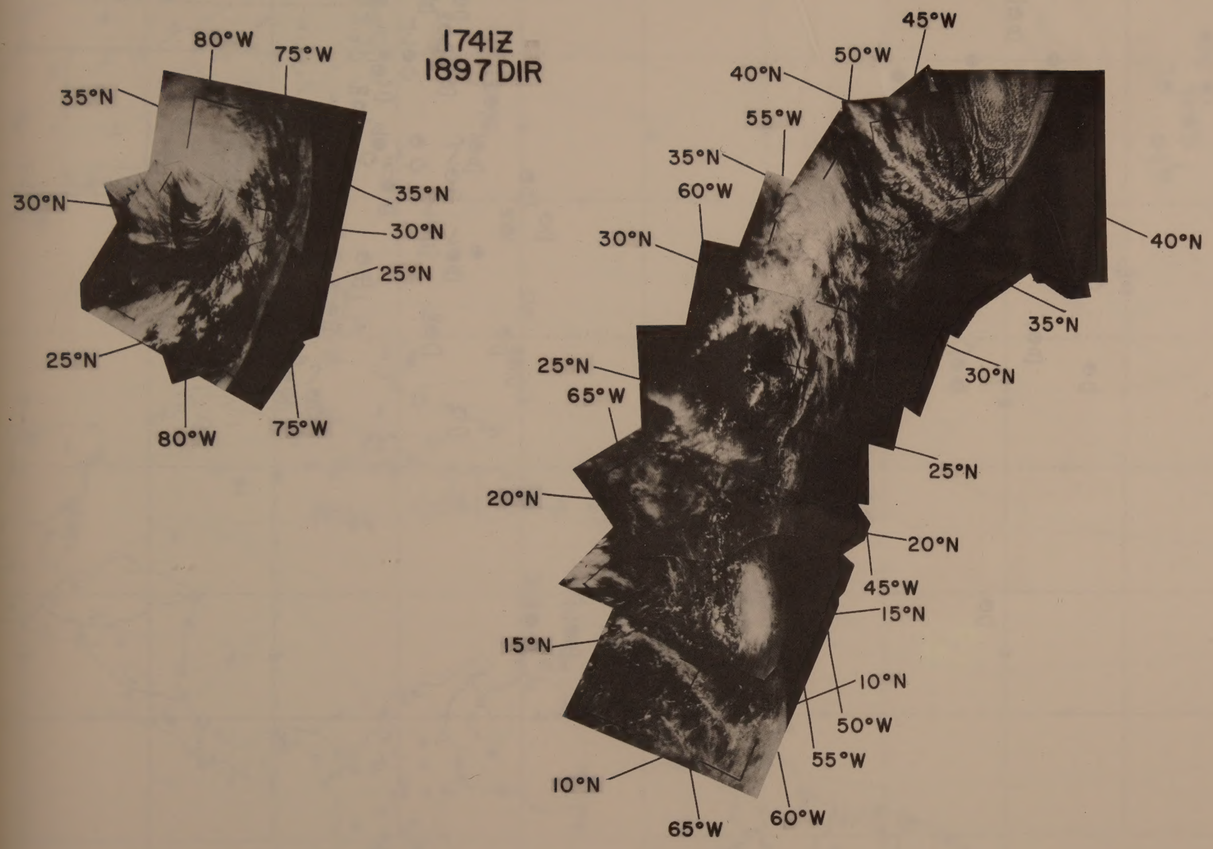
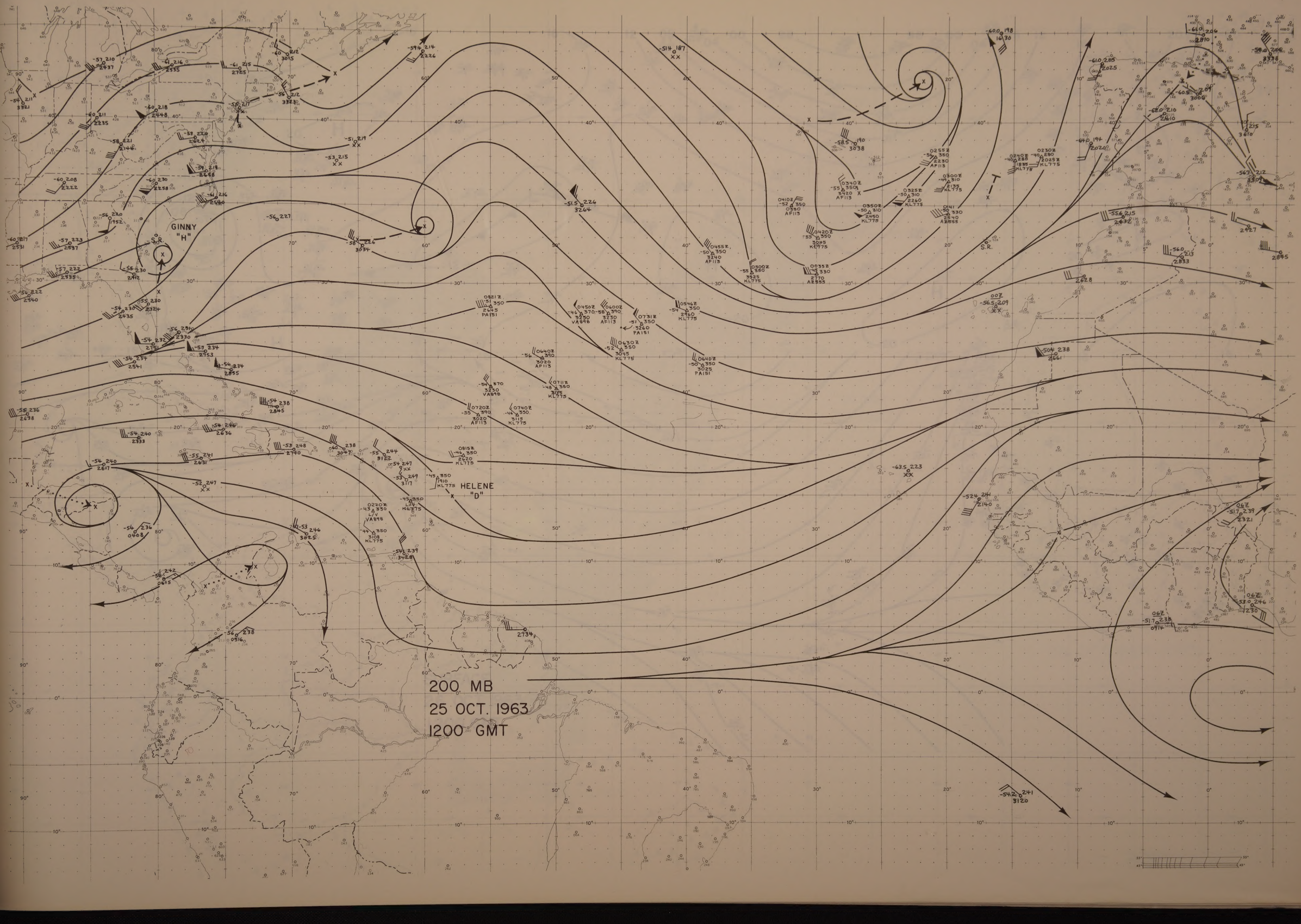
SURFACE
25 OCT. 1963
1200 GMT



25 OCTOBER 1963

CLOUD MAP
25 OCT. 1963
1200 GMT


GINNY
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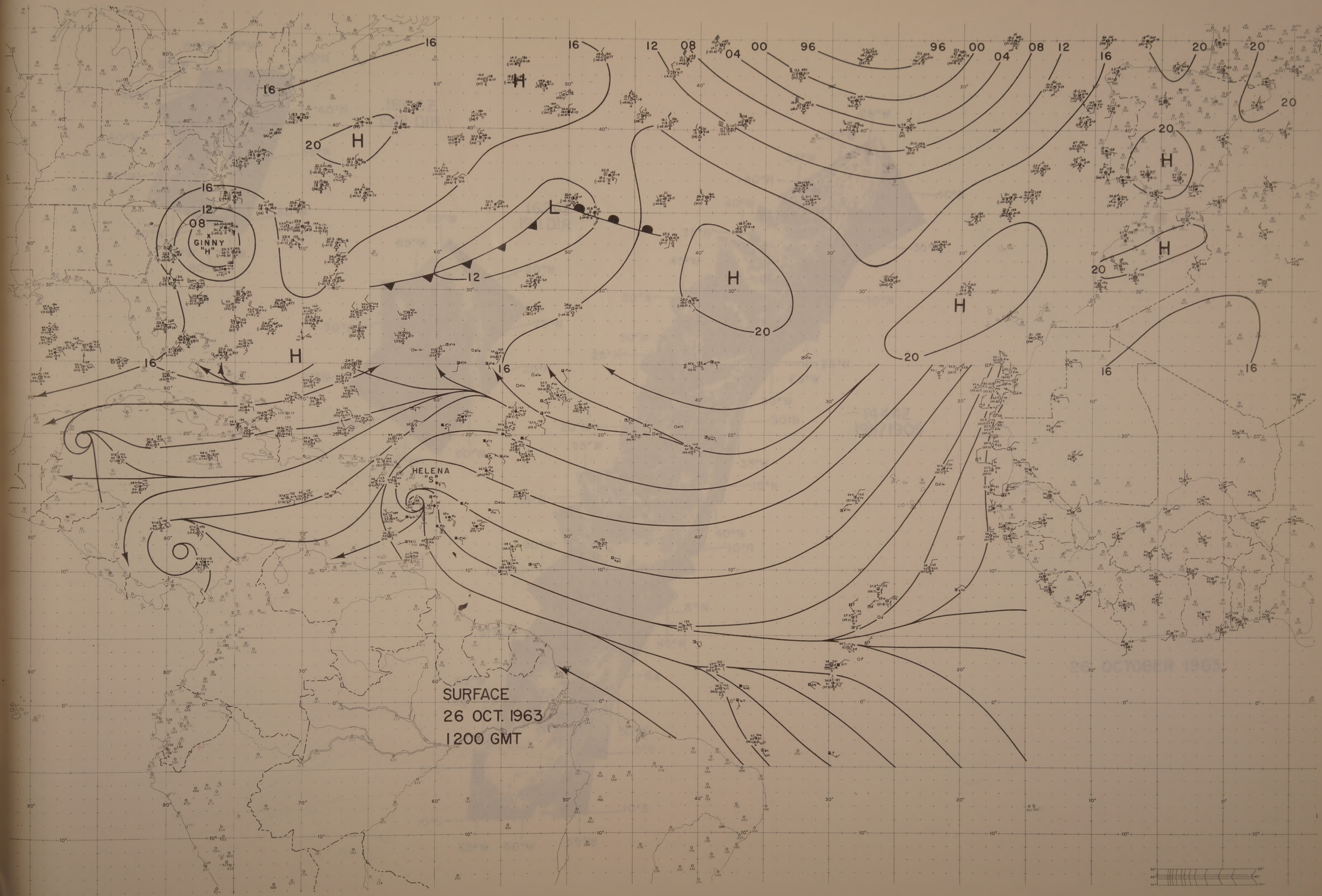
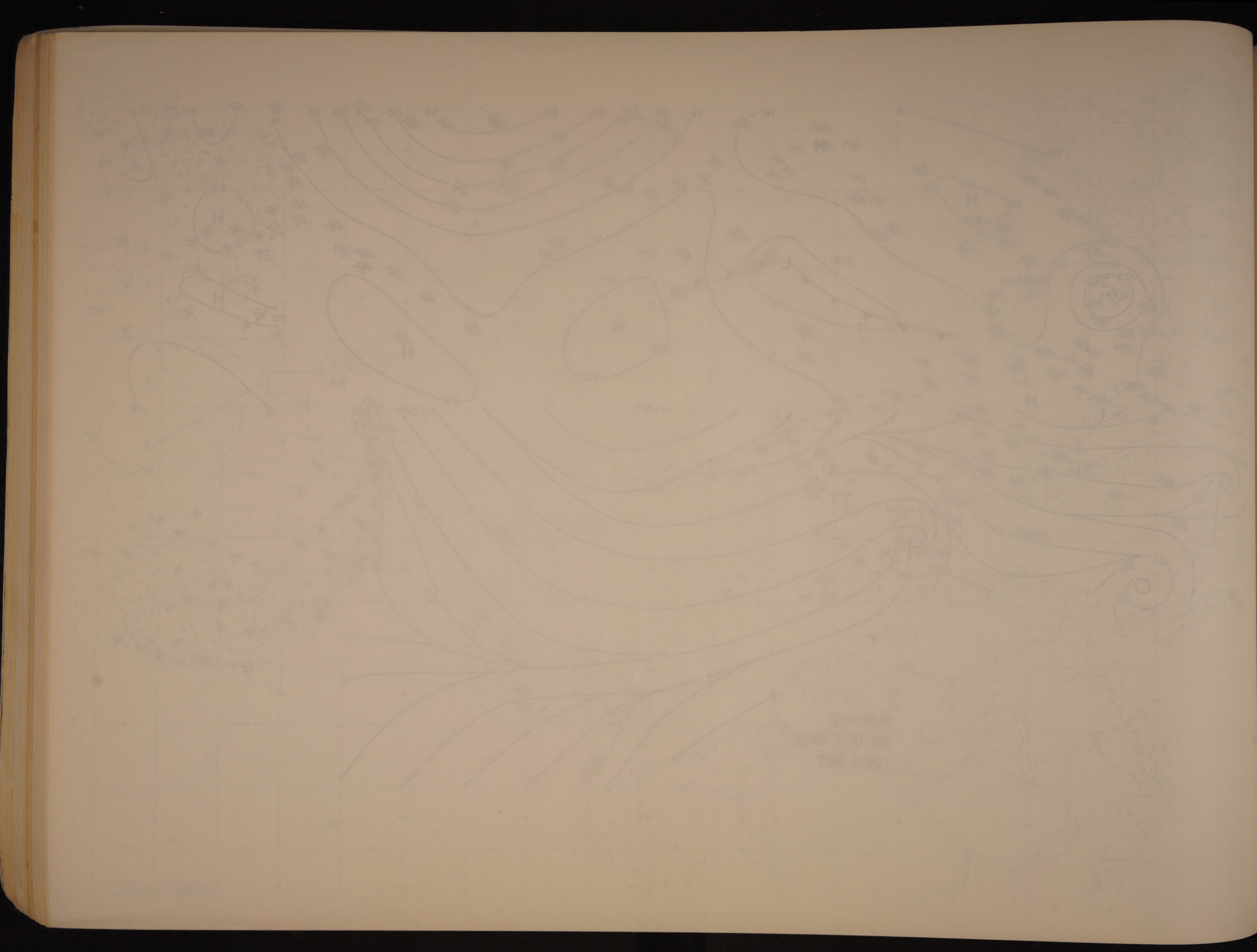
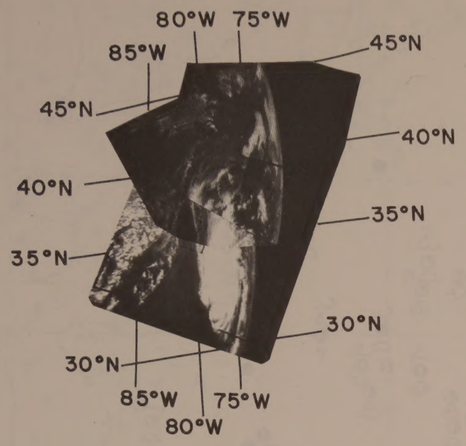
HELENE
"D"
200 MB
25 OCT. 1963
1200 GMT

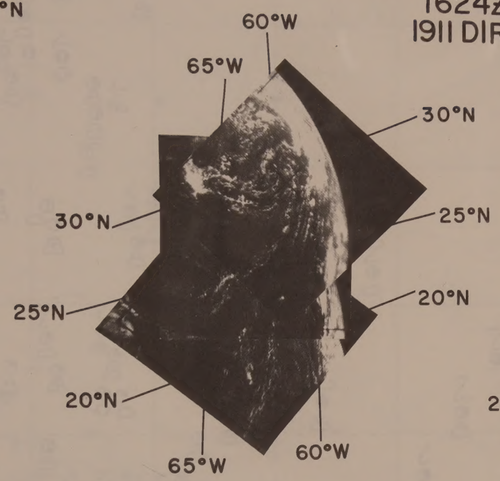
200 MB
25 OCT 1962
1200 GMT


GINNY
"H"
HELENA
"S"
SURFACE
26 OCT. 1963
1200 GMT





1806Z
1912 DIR

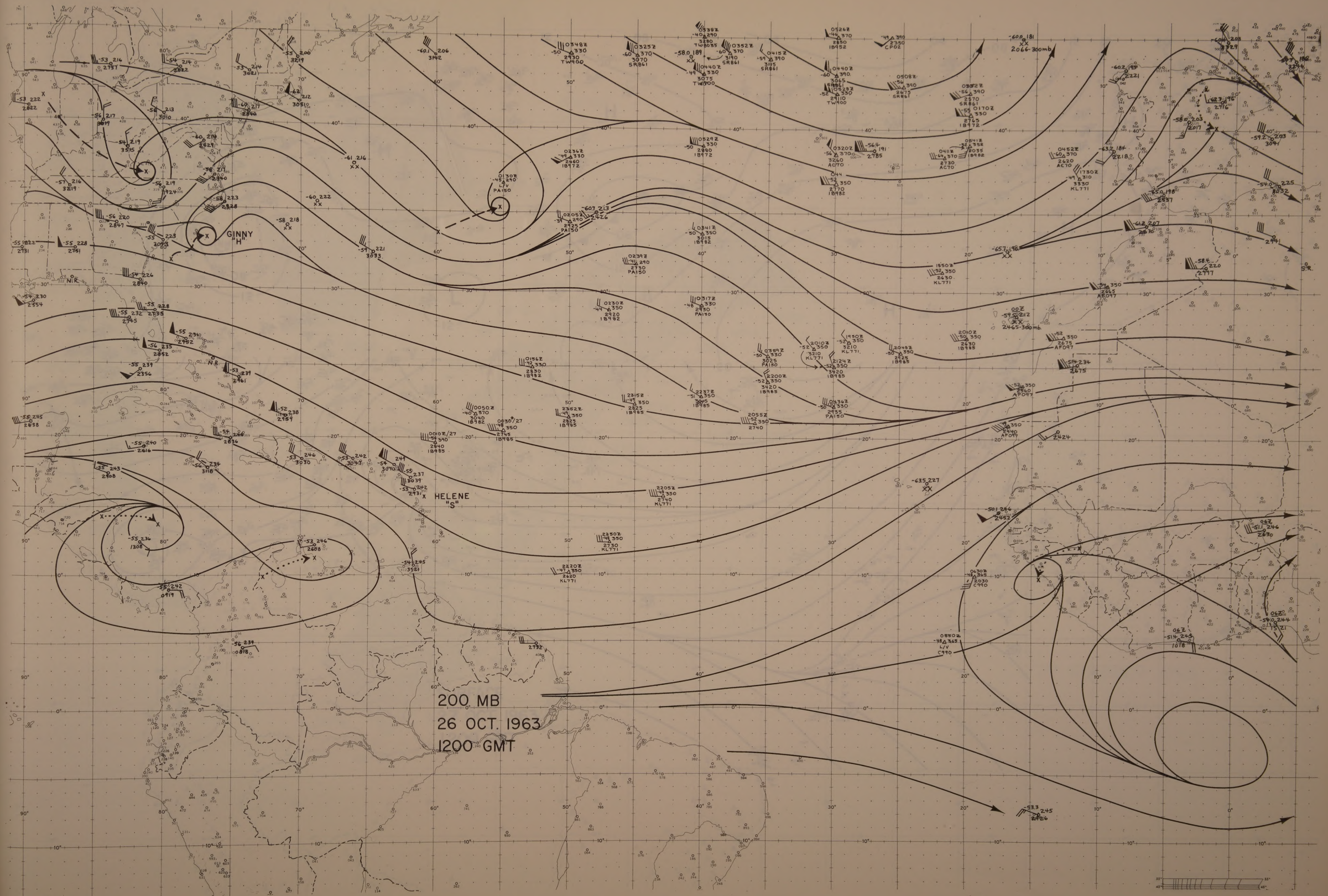


1624Z
1911 DIR

1444Z
1911/1909

26 OCTOBER 1963

CLOUD MAP
26 OCT. 1963
1200 GMT


GINNY
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"S"
2066-300mb
2465-300mb
200 MB
26 OCT. 1963
1200 GMT

GINNY
"H"

HELENA
"S"

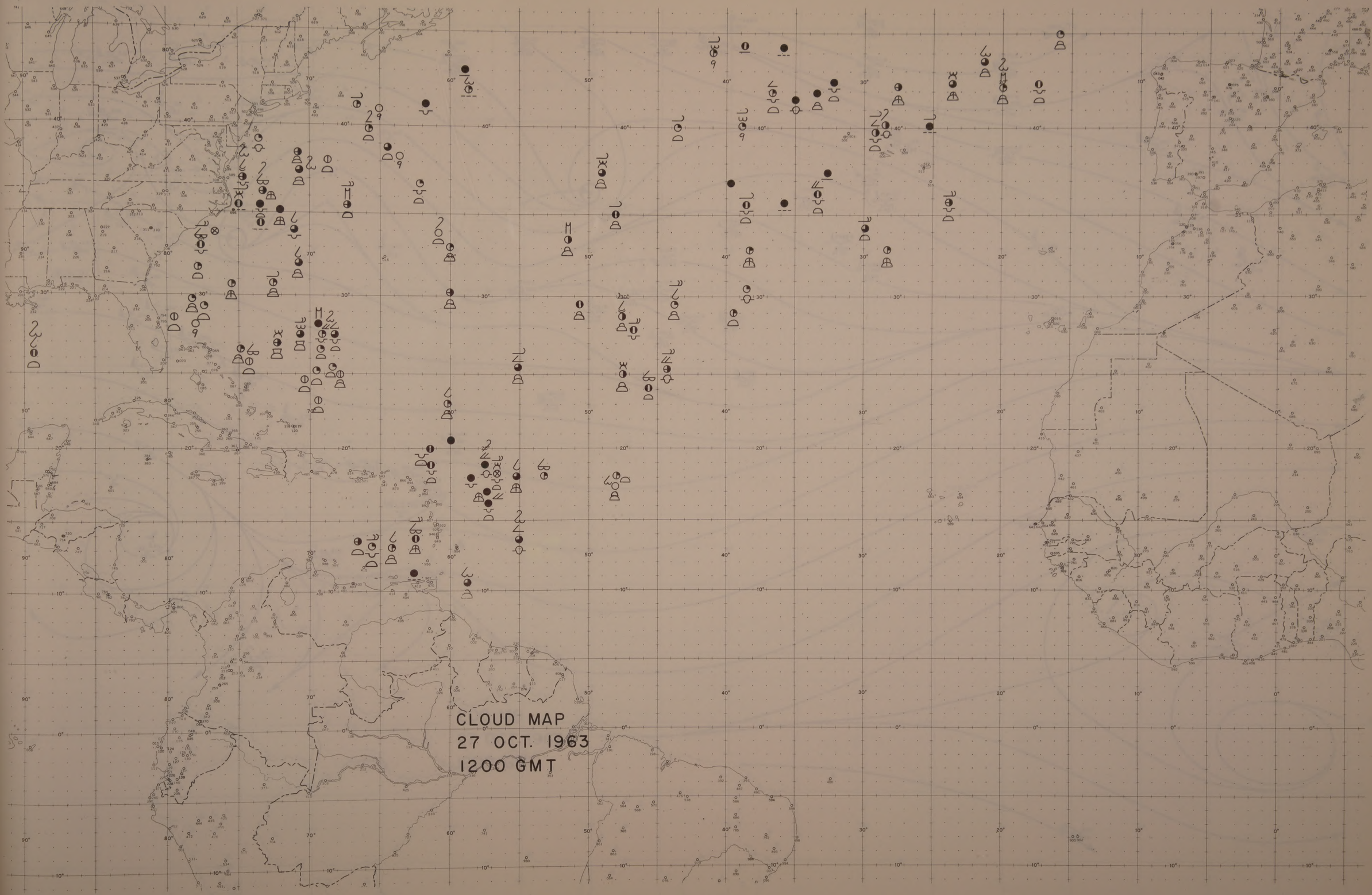
SURFACE
27 OCT. 1963
1200 GMT

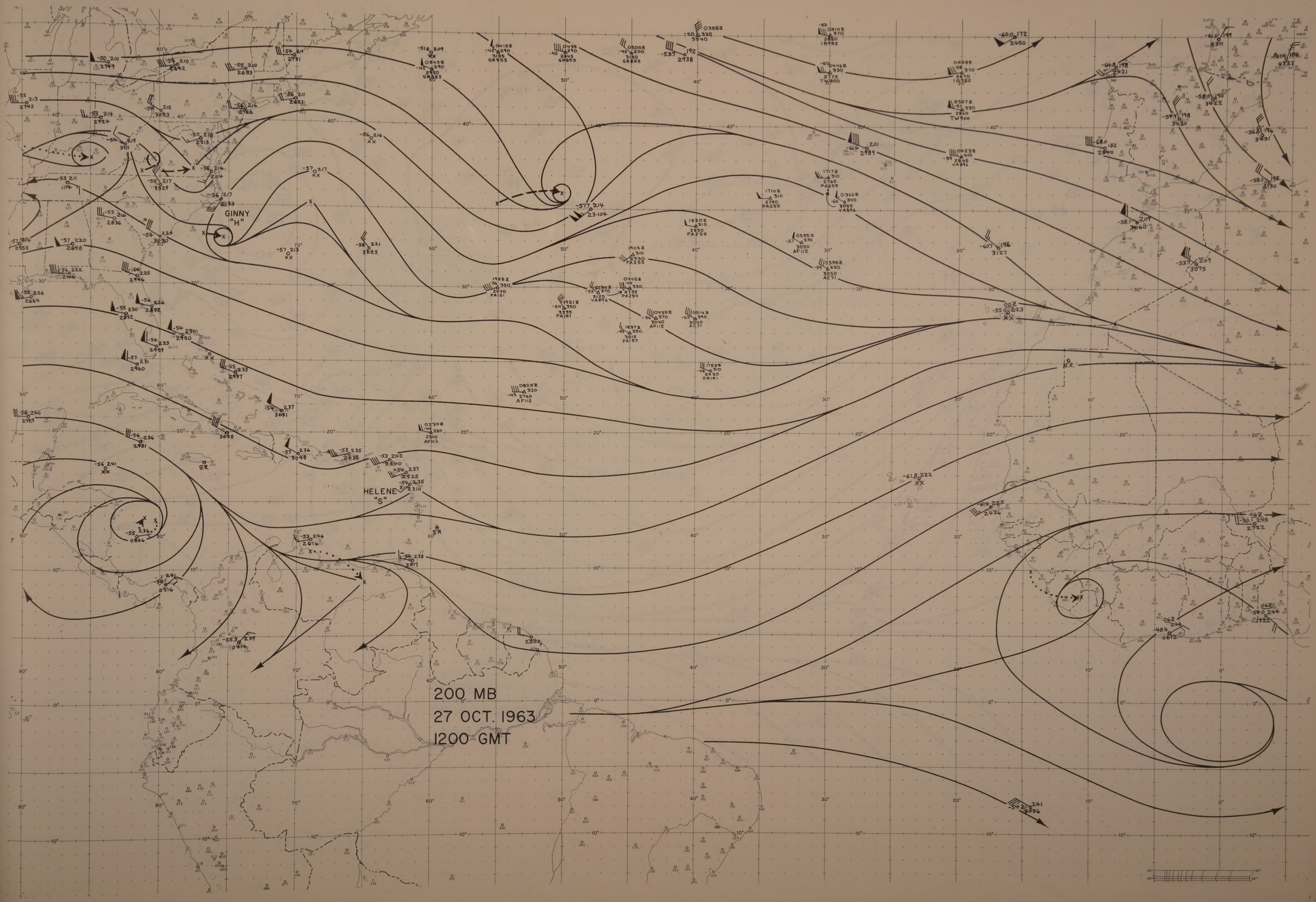
1820Z
1927/1926

1646Z
1926 DIR

1508Z
1926/1925

27 OCTOBER 1963


CLOUD MAP
27 OCT. 1963
1200 GMT


GINNY
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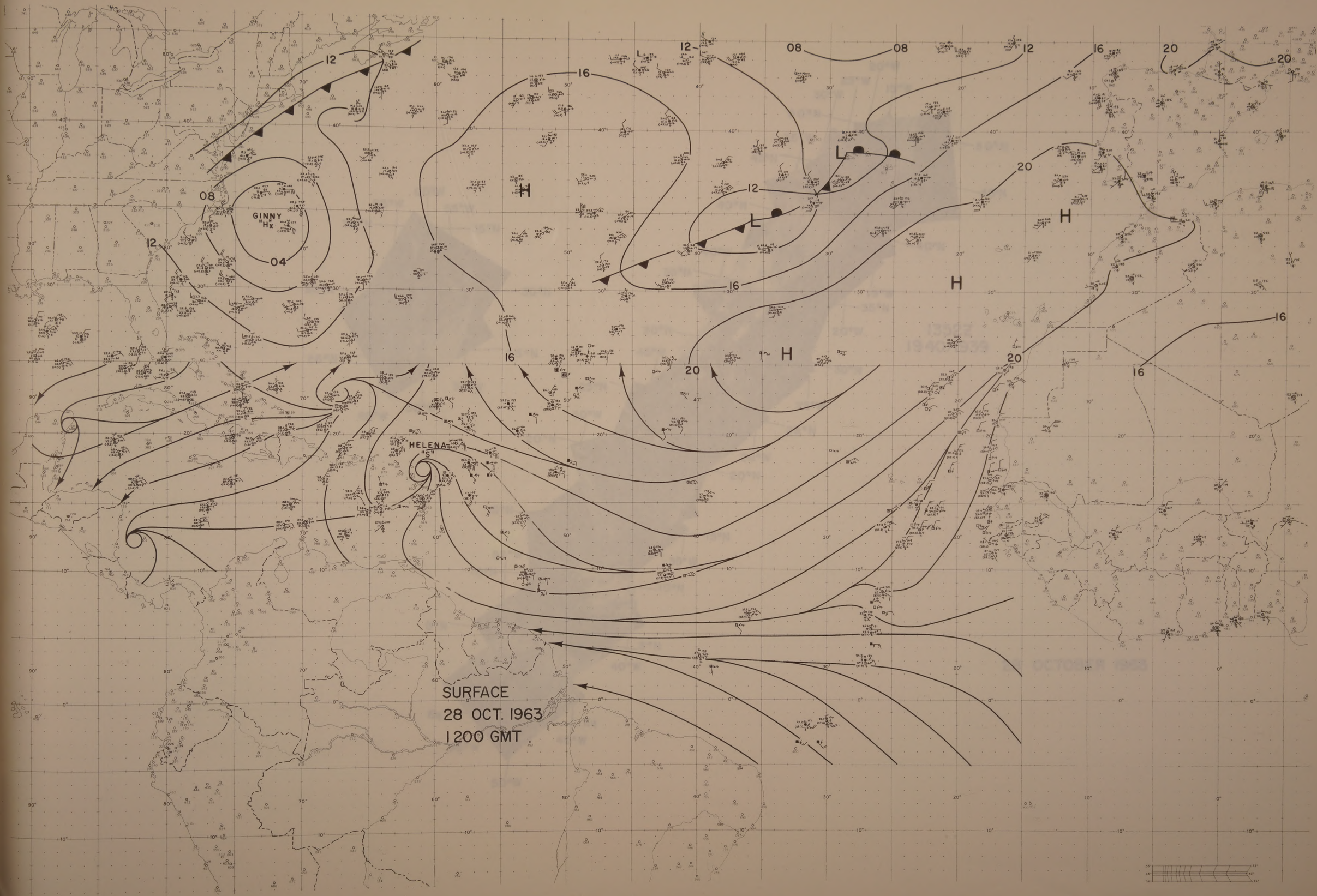
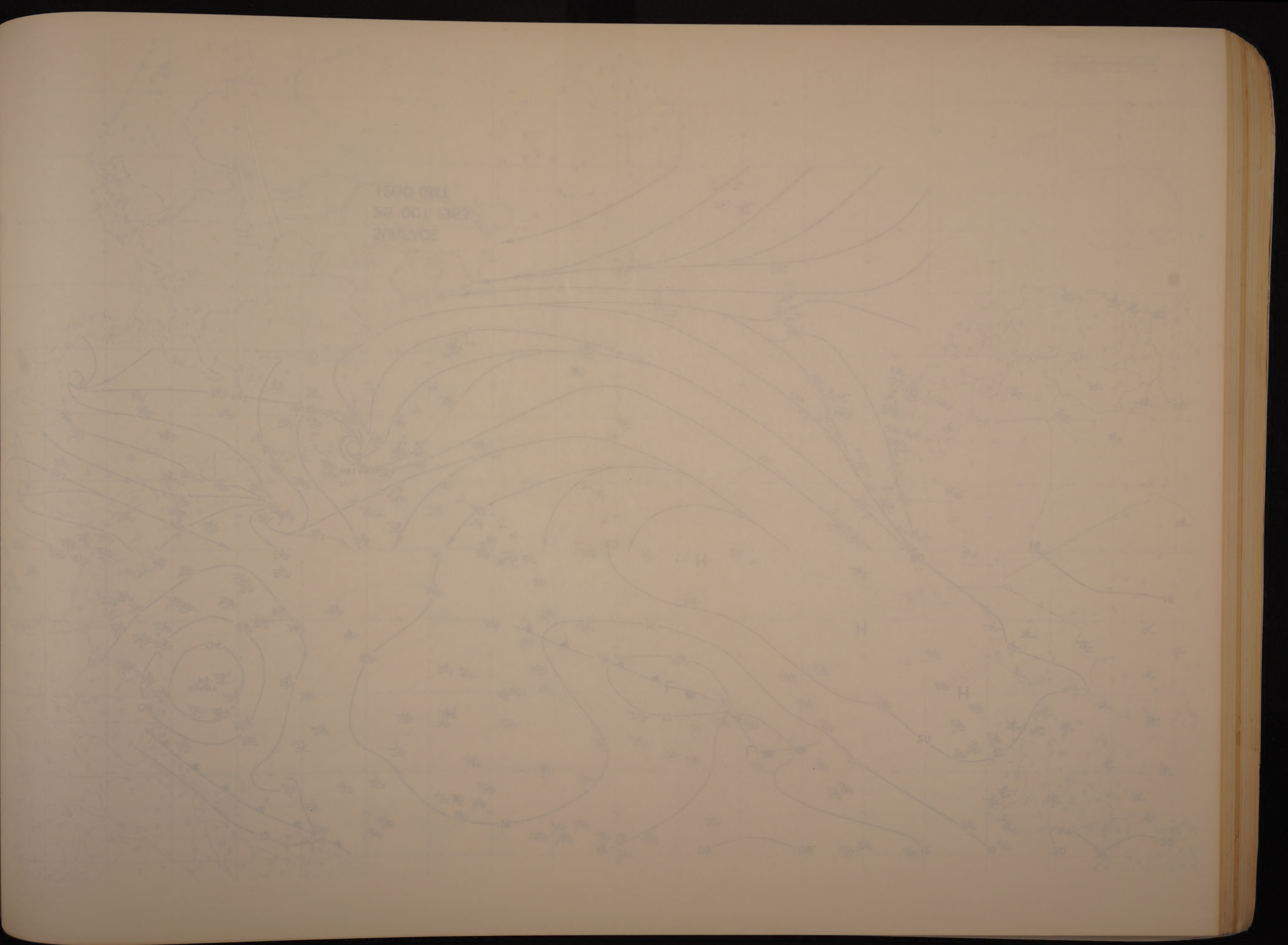
200 MB
27 OCT. 1963
1200 GMT


GINNY
"Hx
HELENA
"S"
SURFACE
28 OCT. 1963
1200 GMT



1352Z
1940/1939

28 OCTOBER 1963

CLOUD MAP
28 OCT. 1963
1200 GMT

CLOUD MAP
28 OCT 1963
1200 GMT

GINNY
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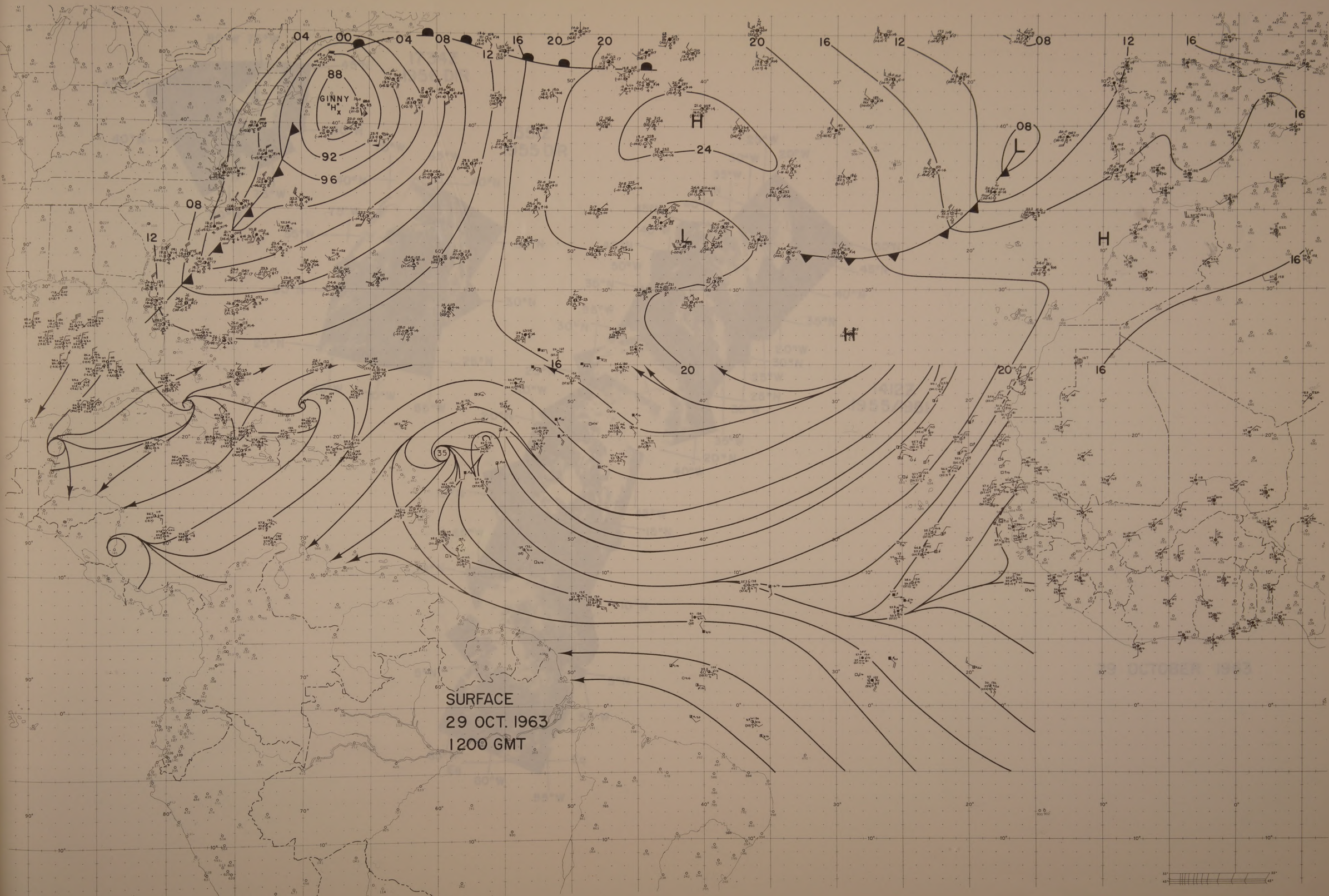
200 MB
28 OCT. 1963
1200 GMT

1500 CIRC
30 OCT 1962
500 NB


GINNY
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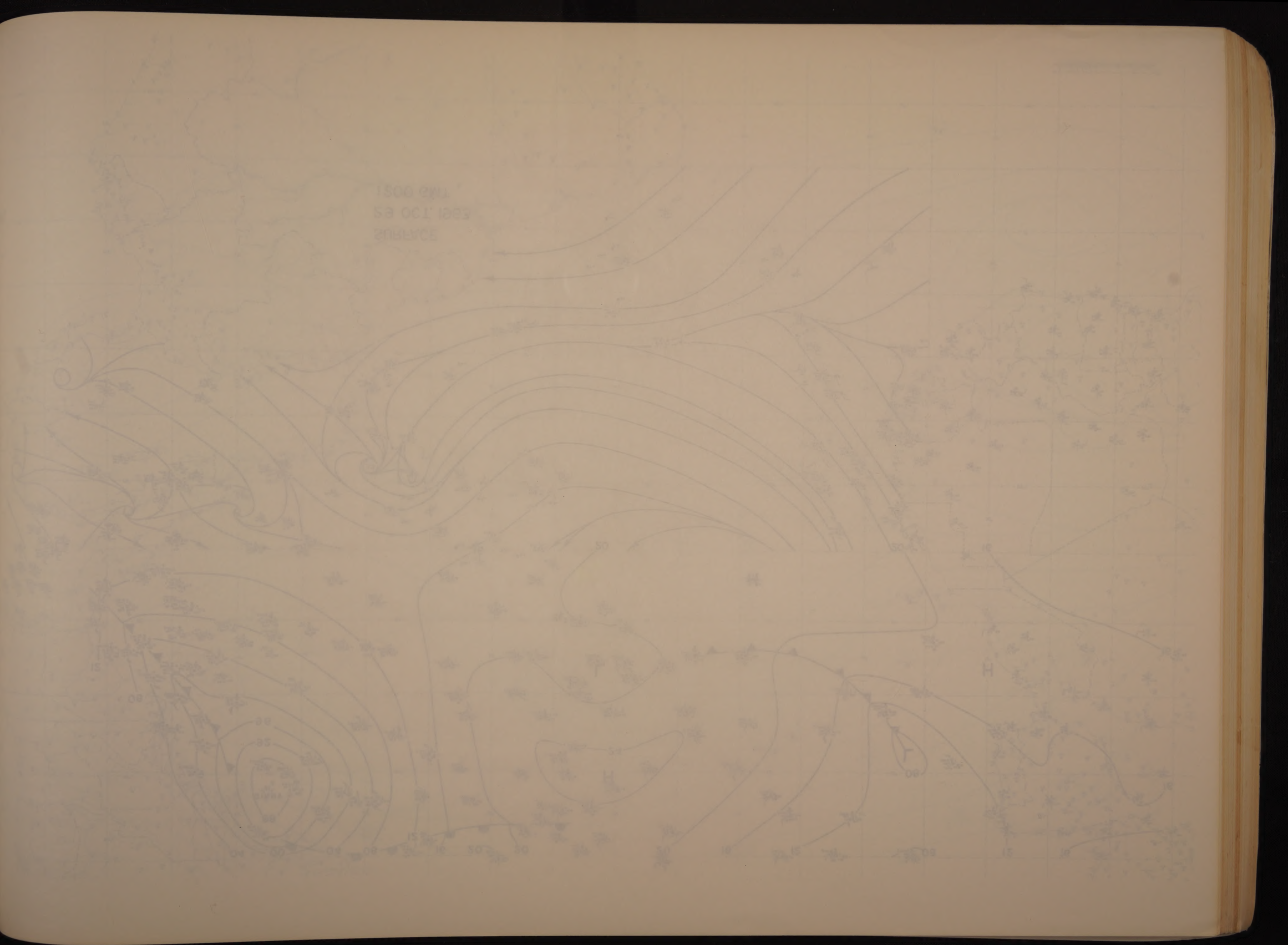
SURFACE
29 OCT. 1963
1200 GMT



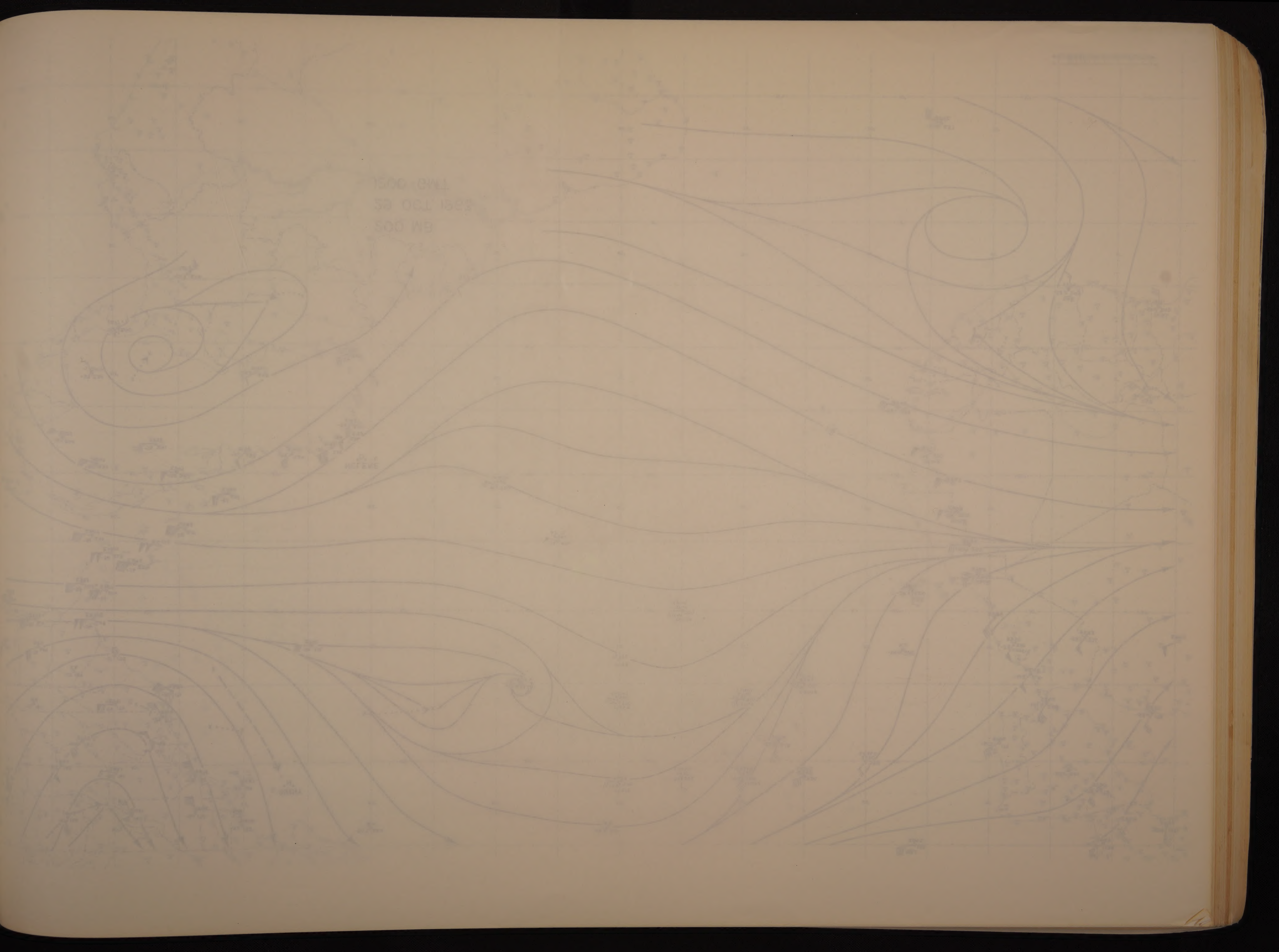
29 OCTOBER 1963

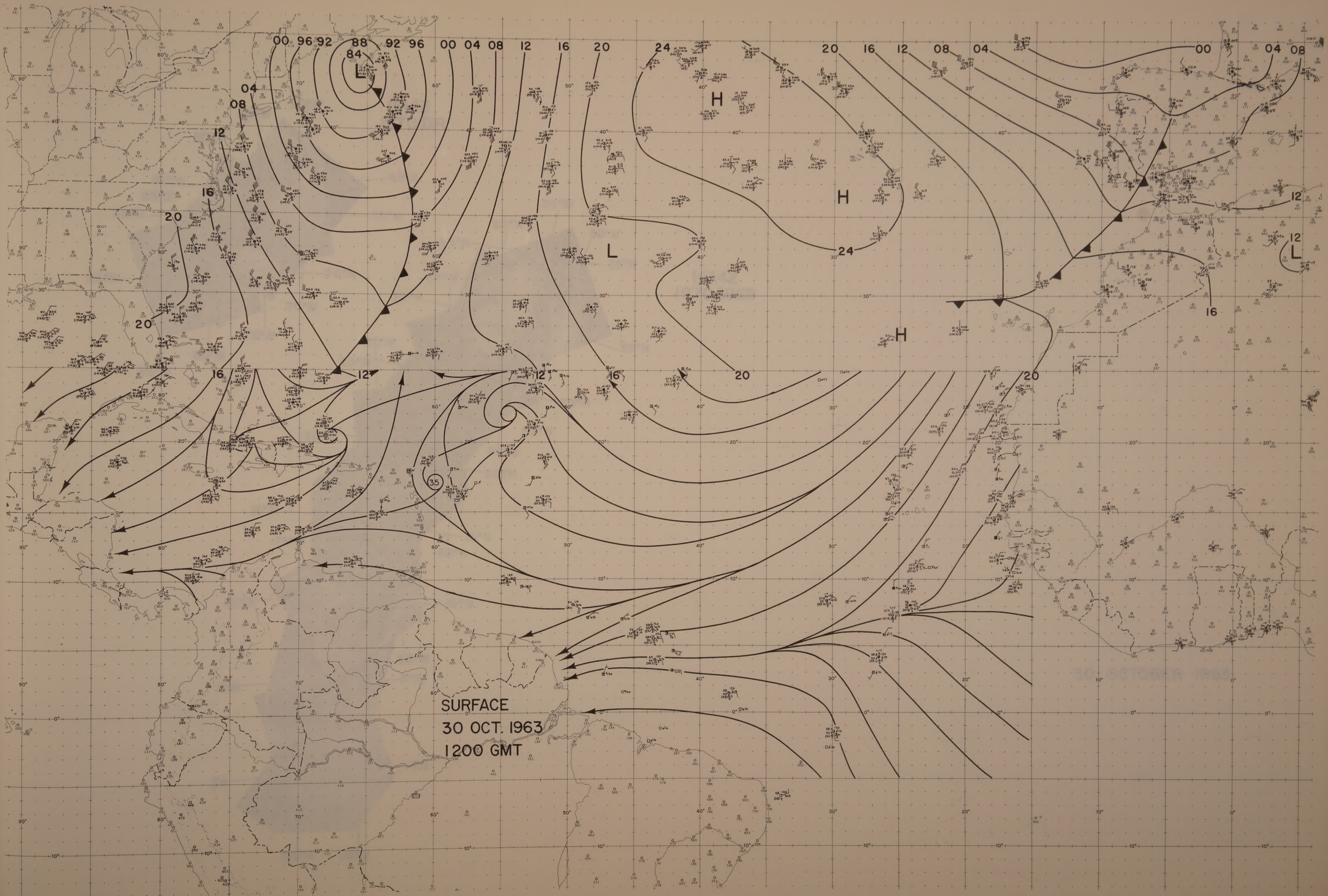
CLOUD MAP
29 OCT. 1963
1200 GMT

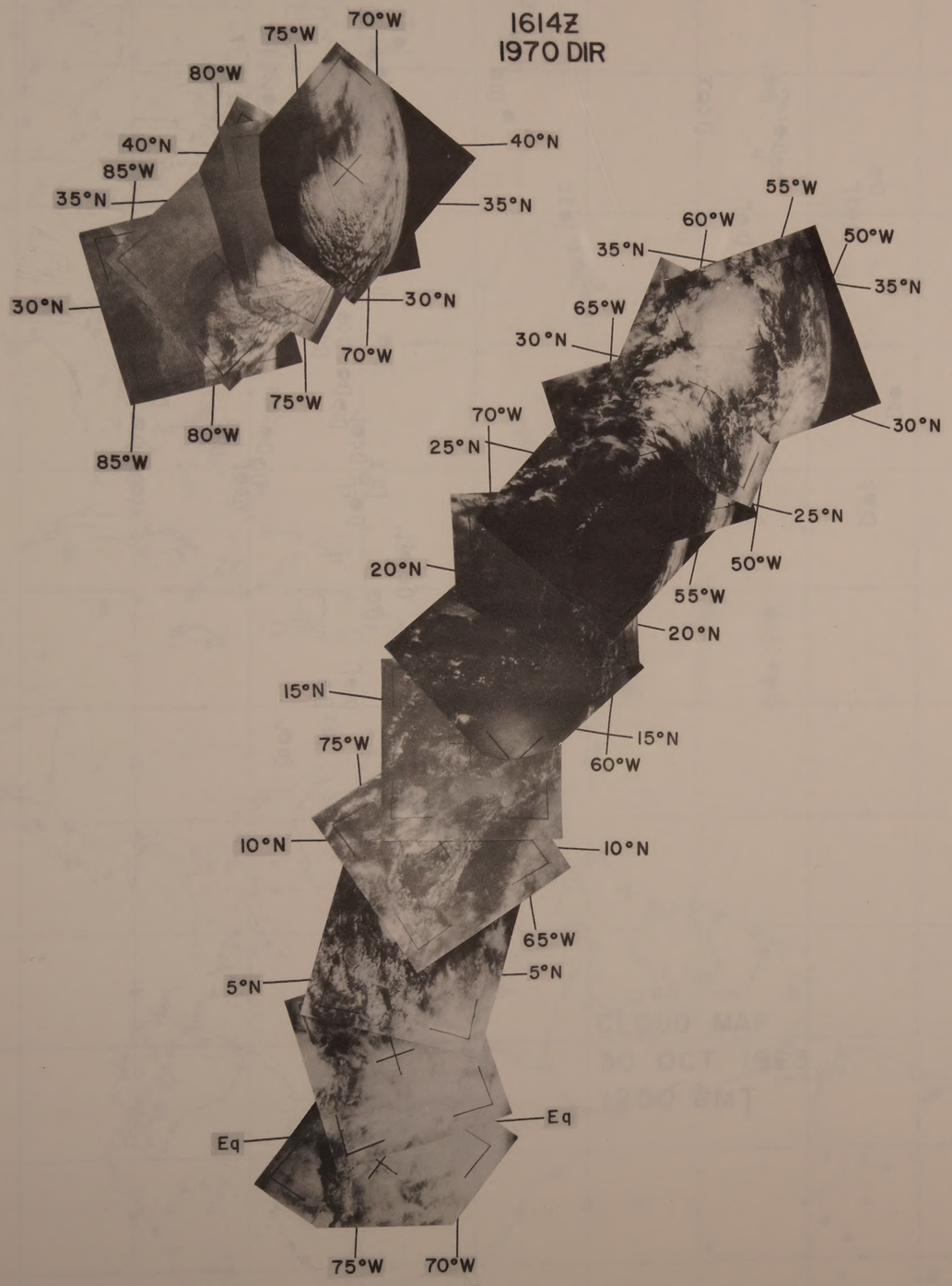
GINNY
"H"

HELENE
"D"

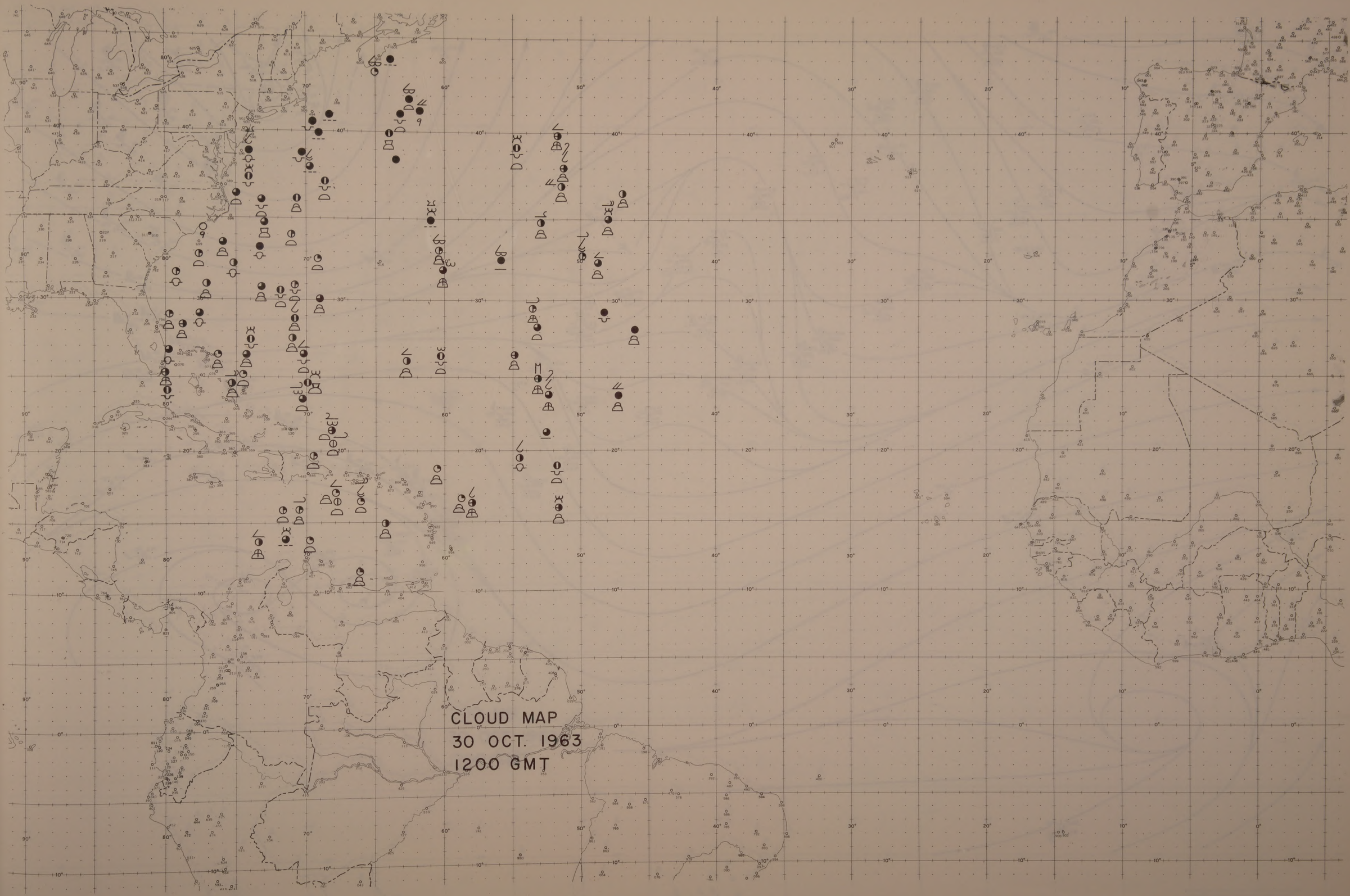
200 MB
29 OCT. 1963
1200 GMT

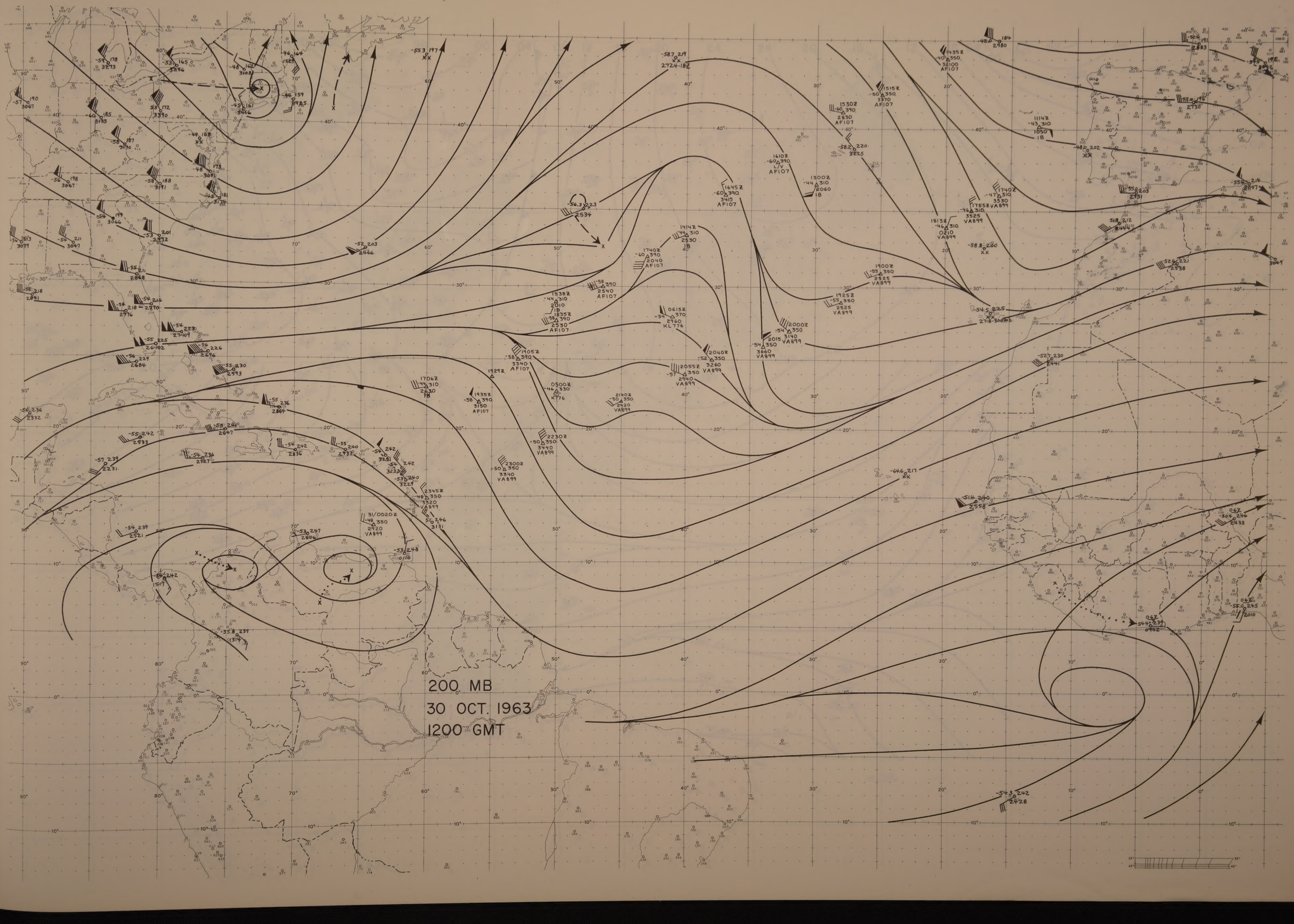


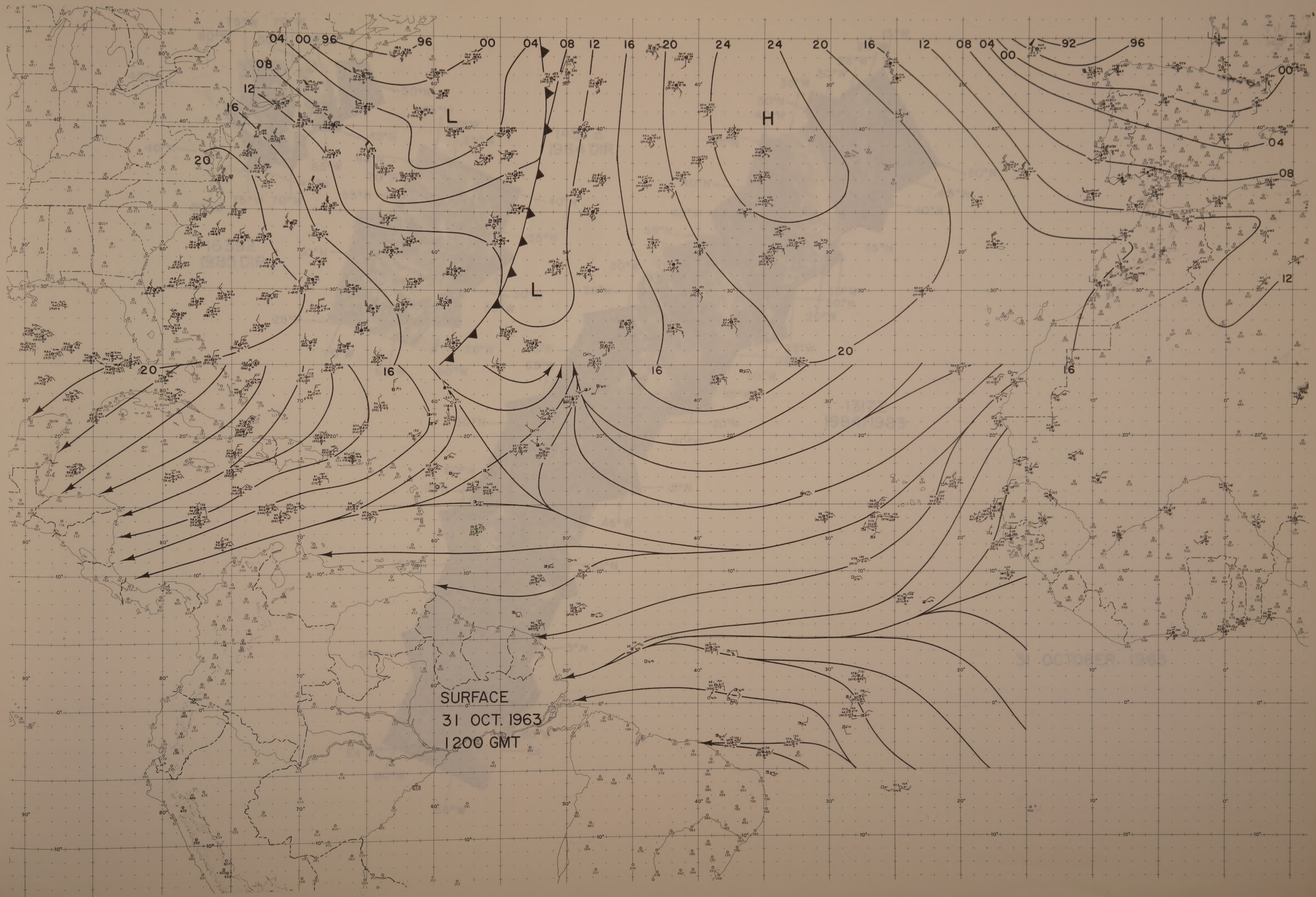

SURFACE
30 OCT. 1963
1200 GMT



30 OCTOBER 1963


CLOUD MAP
30 OCT. 1963
1200 GMT


200 MB
30 OCT. 1963
1200 GMT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31 OCT. 1963
1200 GMT

1500 GMT
31 OCT 1953
SURFACE

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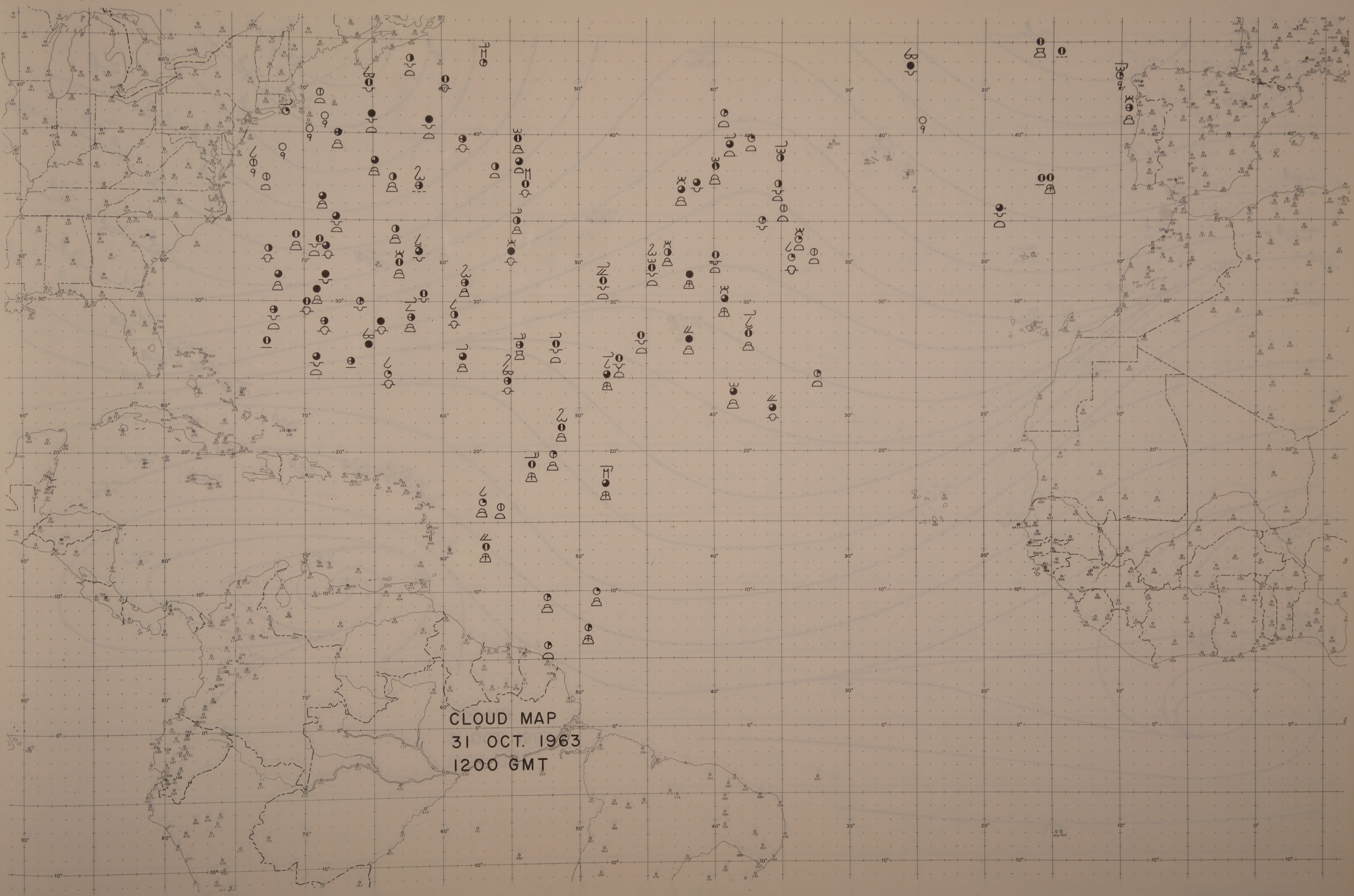
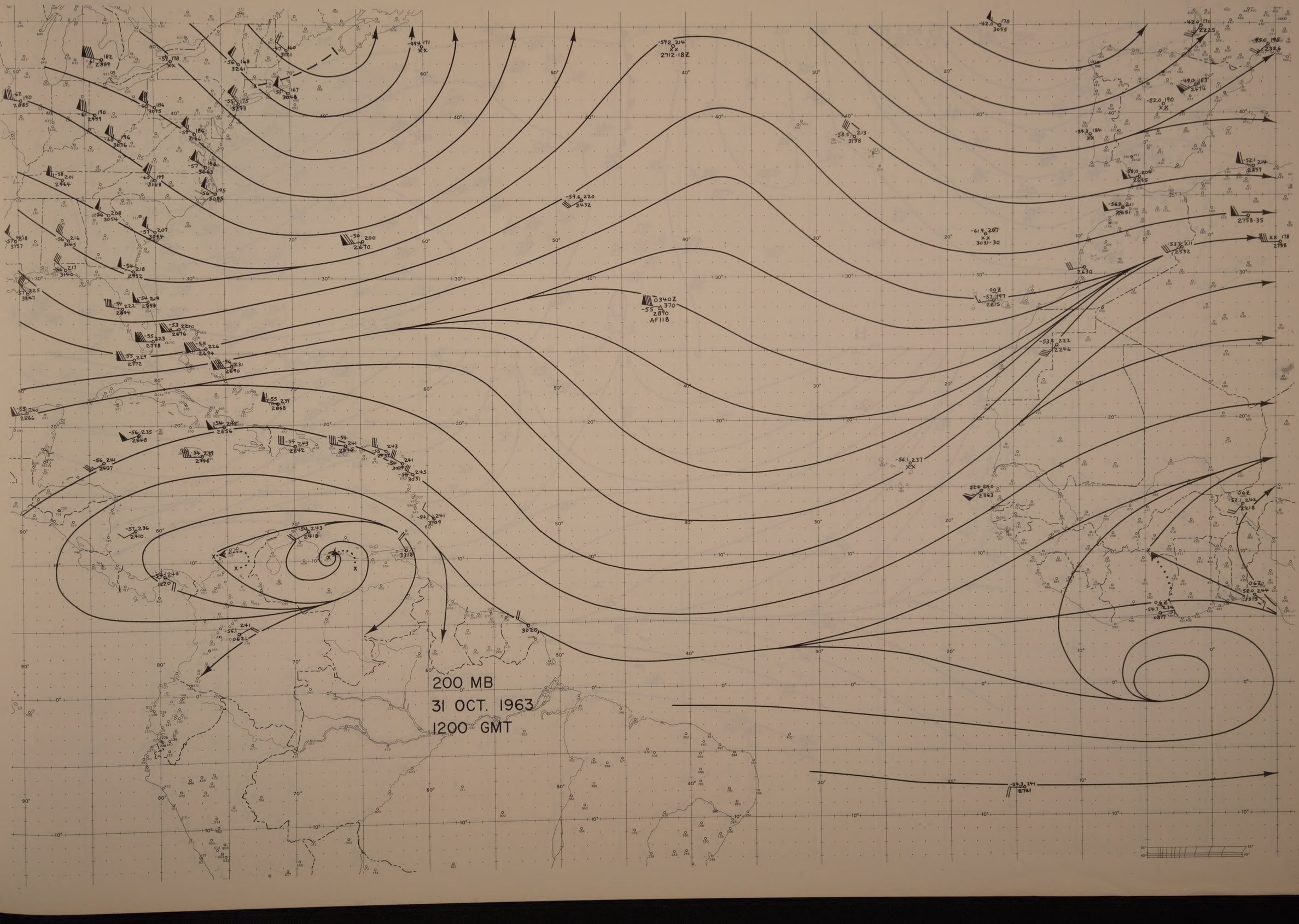
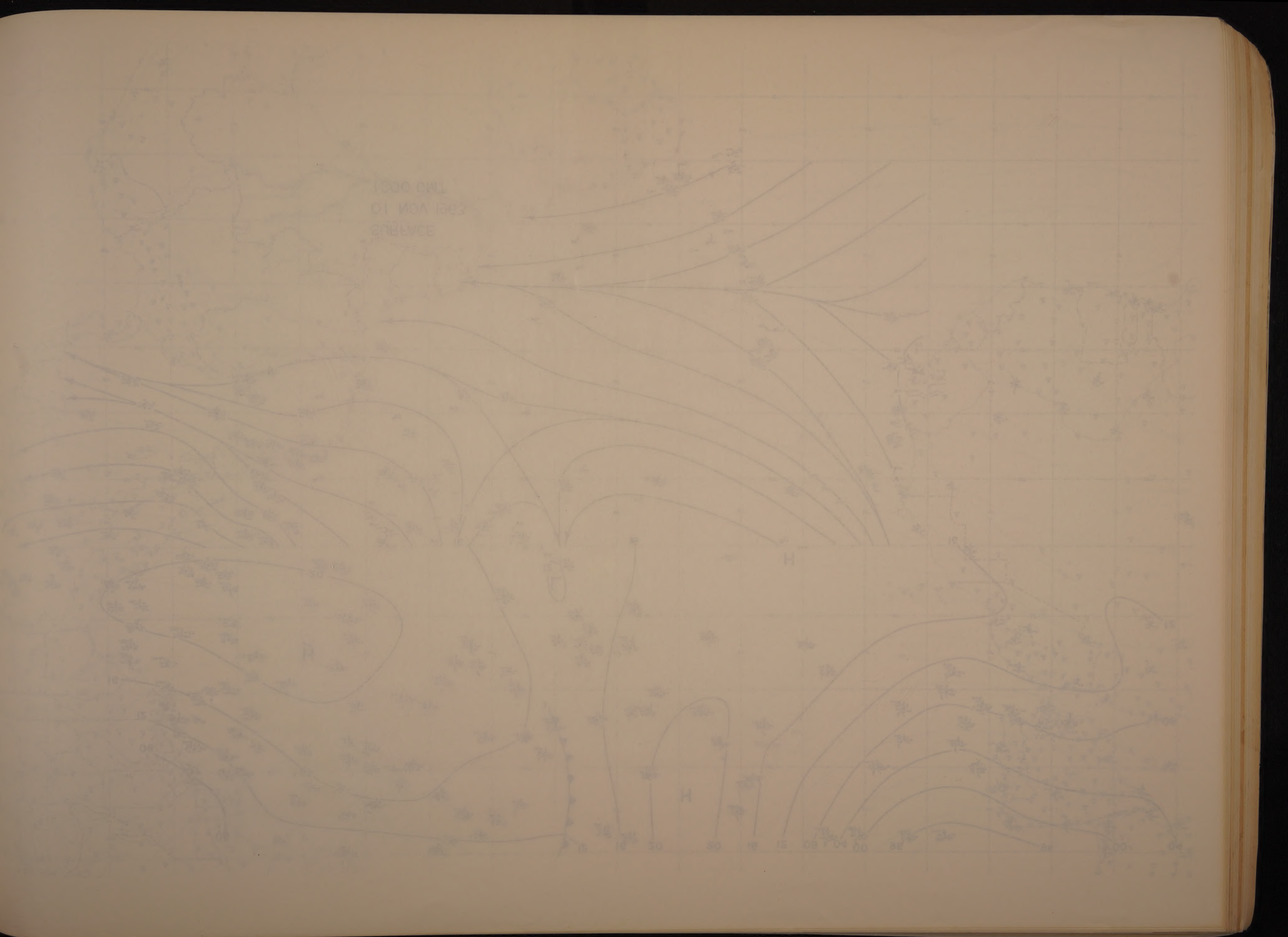
31 OCTOBER 1963


CLOUD MAP
31 OCT. 1963
1200 GMT


200 MB
31 OCT. 1963
1200 GMT

SURFACE
01 NOV. 1963
1200 GMT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1519Z
1999 DIR

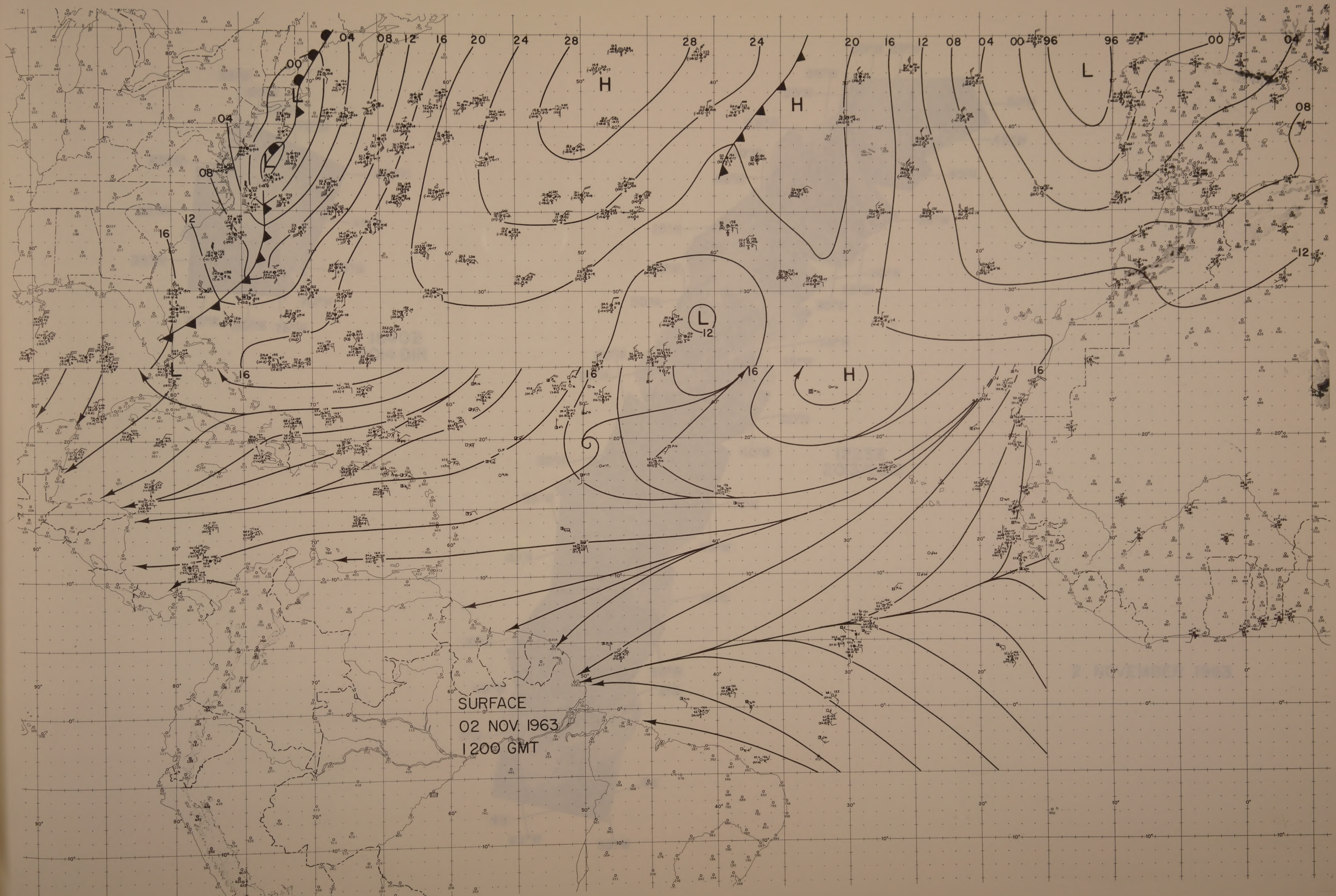
1 NOVEMBER 1963

CLOUD MAP
01 NOV. 1963
1200 GMT

200 MB

1 NOV. 1963

1200 GMT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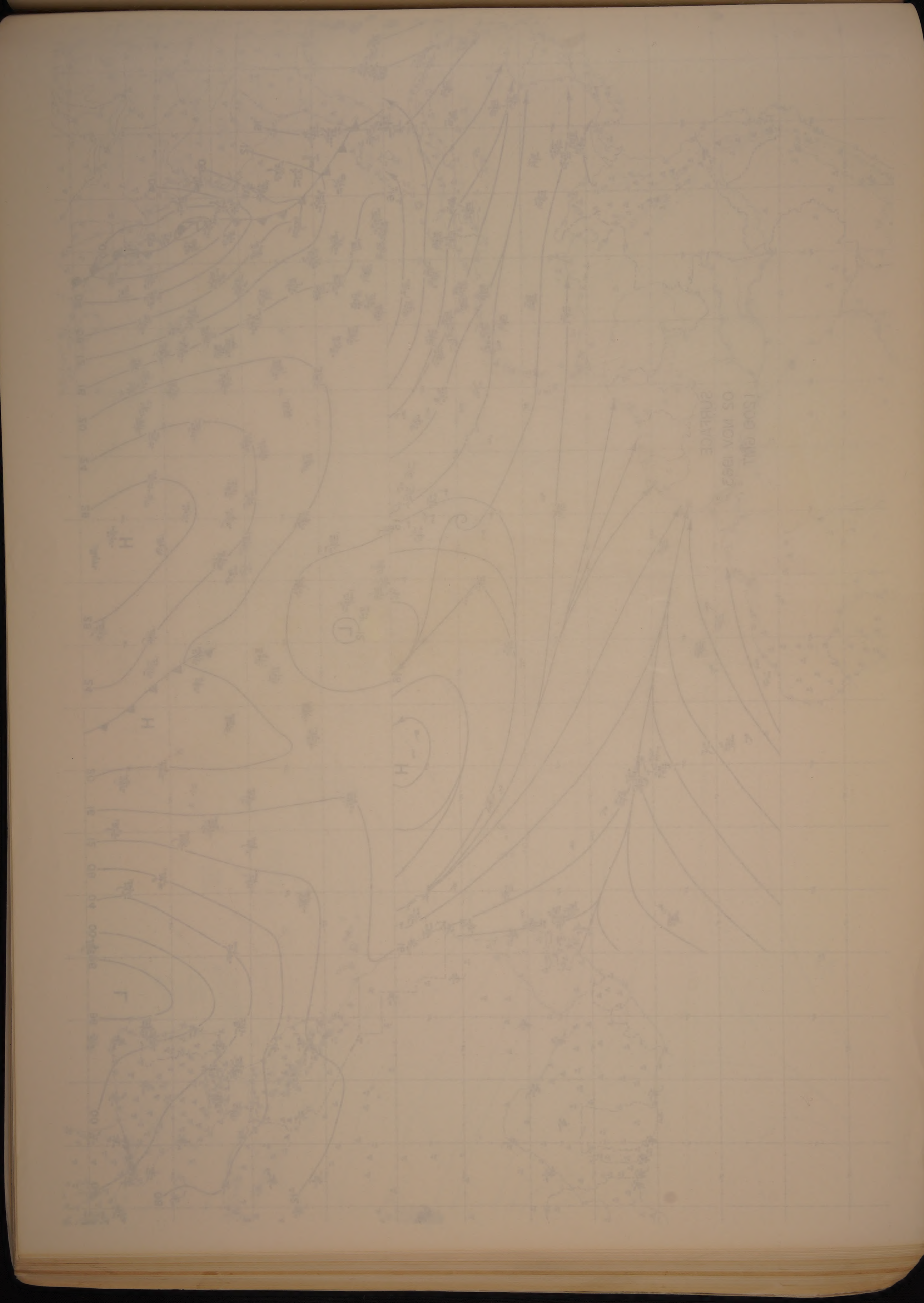

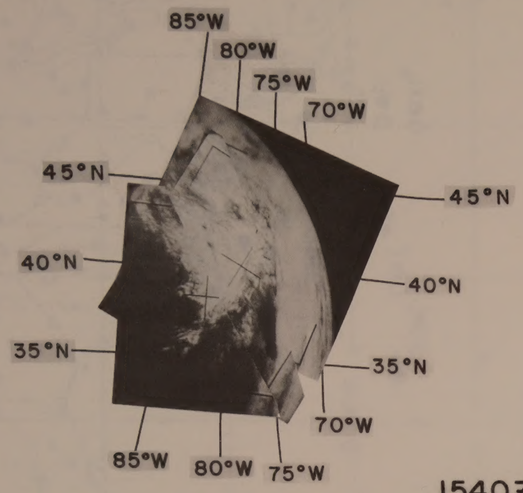

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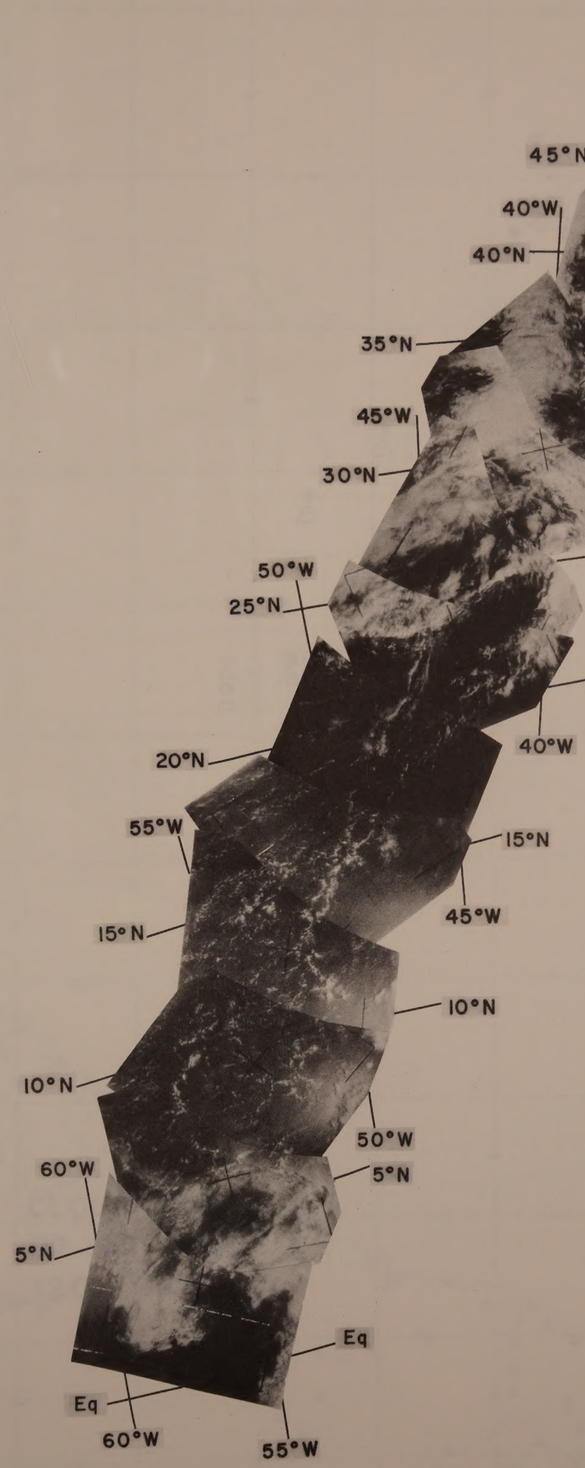
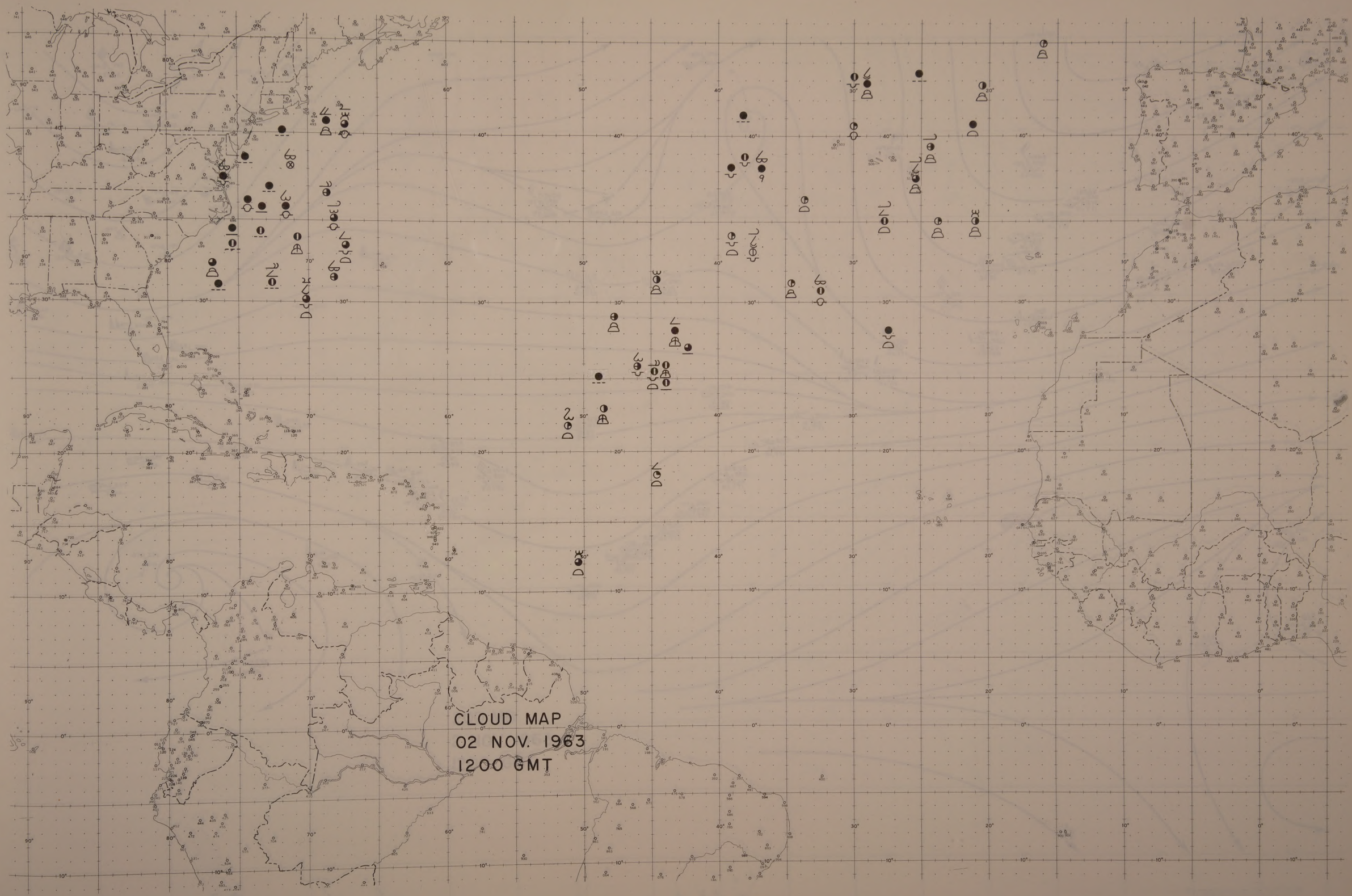
2014 DIR



1223Z
2013/2012

2 NOVEMBER 1963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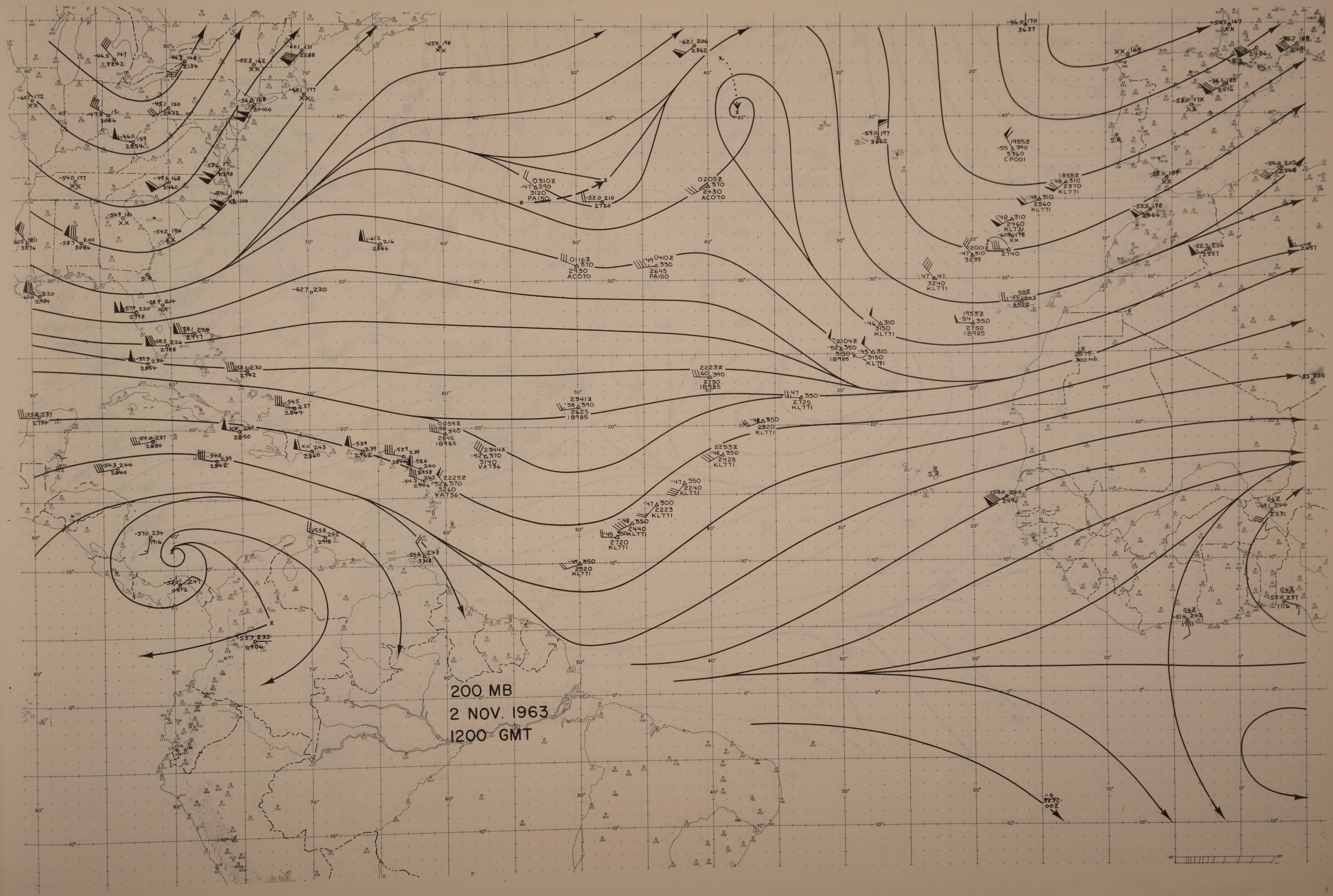
200 MB
2 NOV. 1963
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SURFACE
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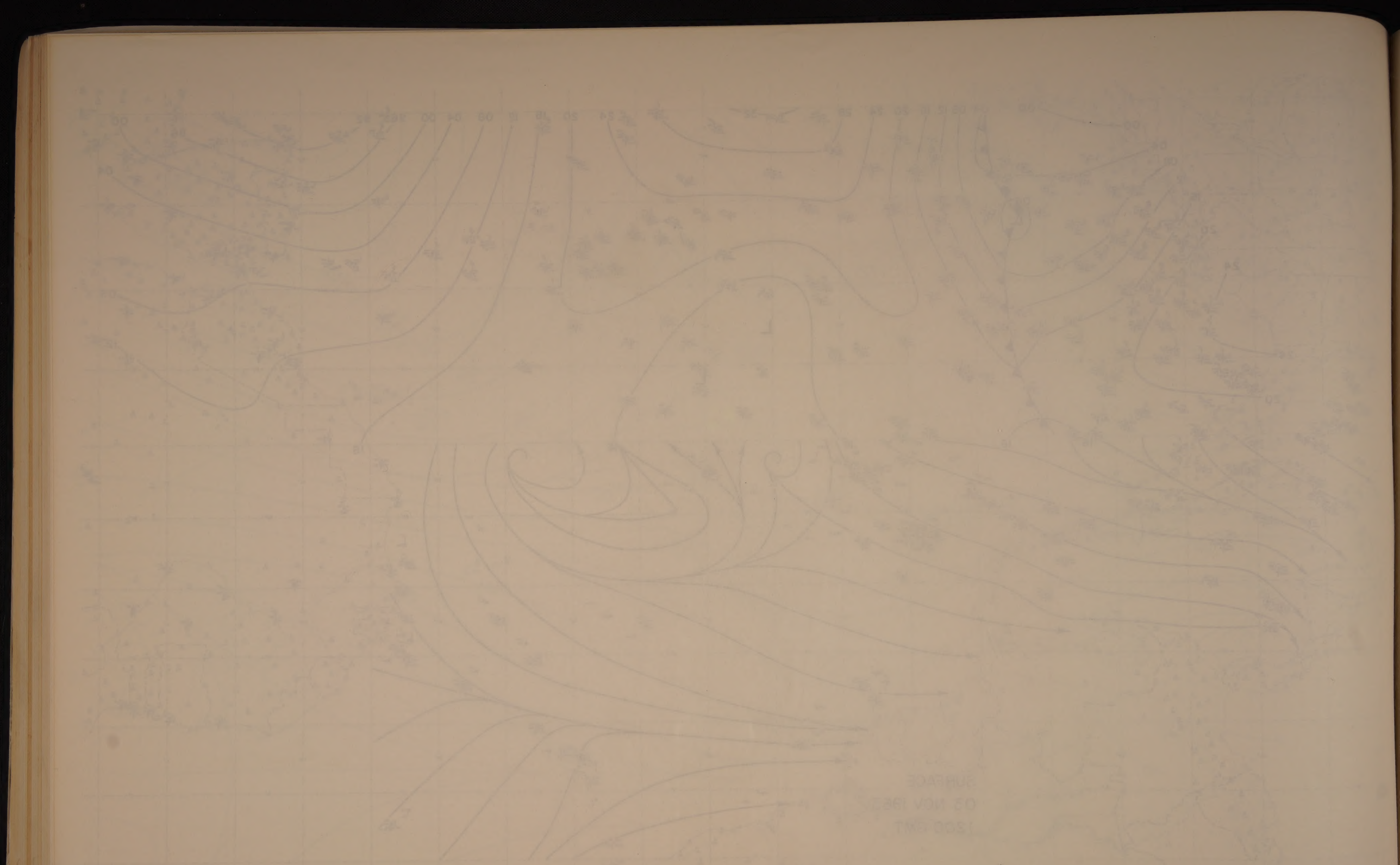

3 NOVEMBER 1963

CLOUD MAP
03 NOV. 1963
1200 GMT

200 MB
3 NOV. 1963
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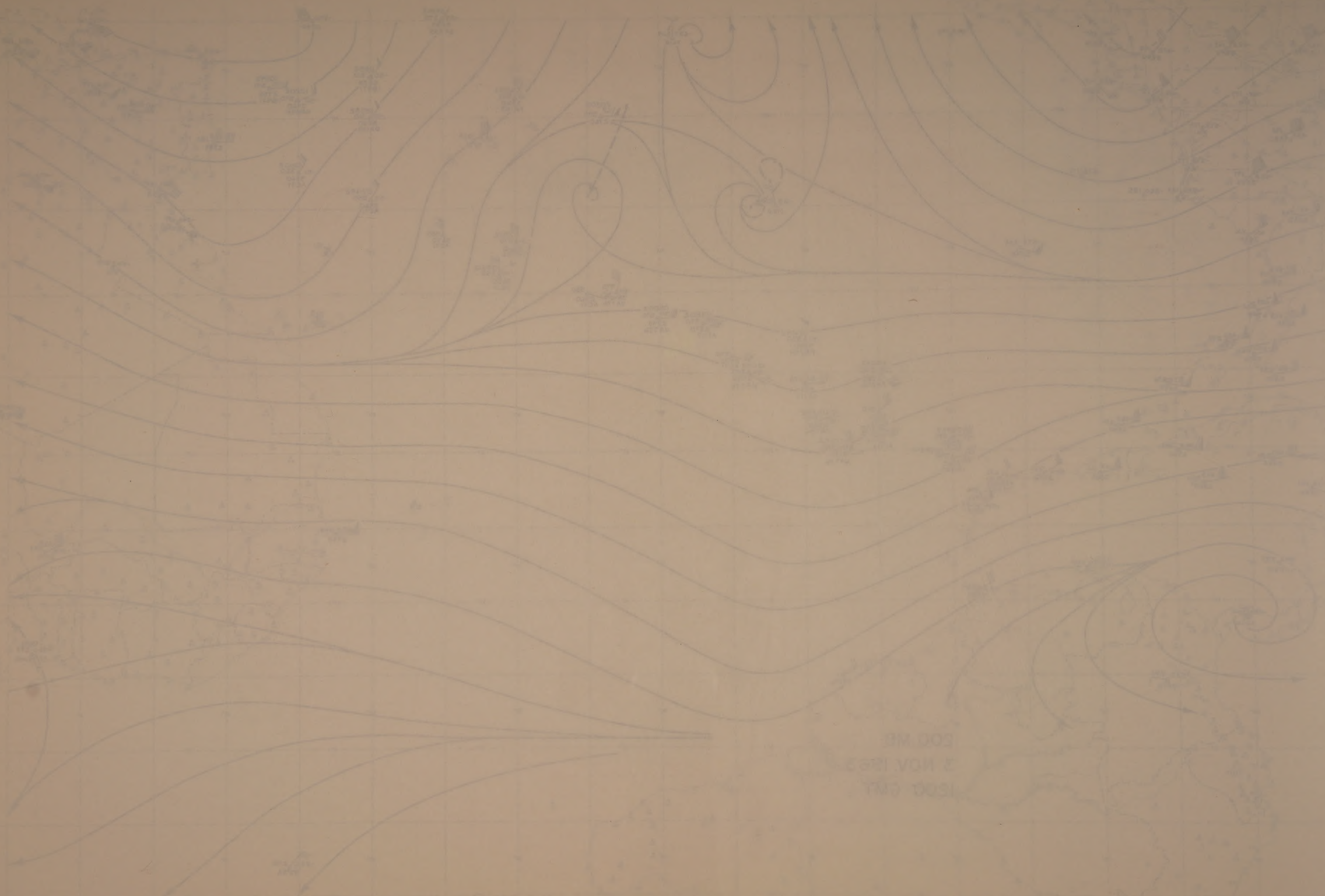

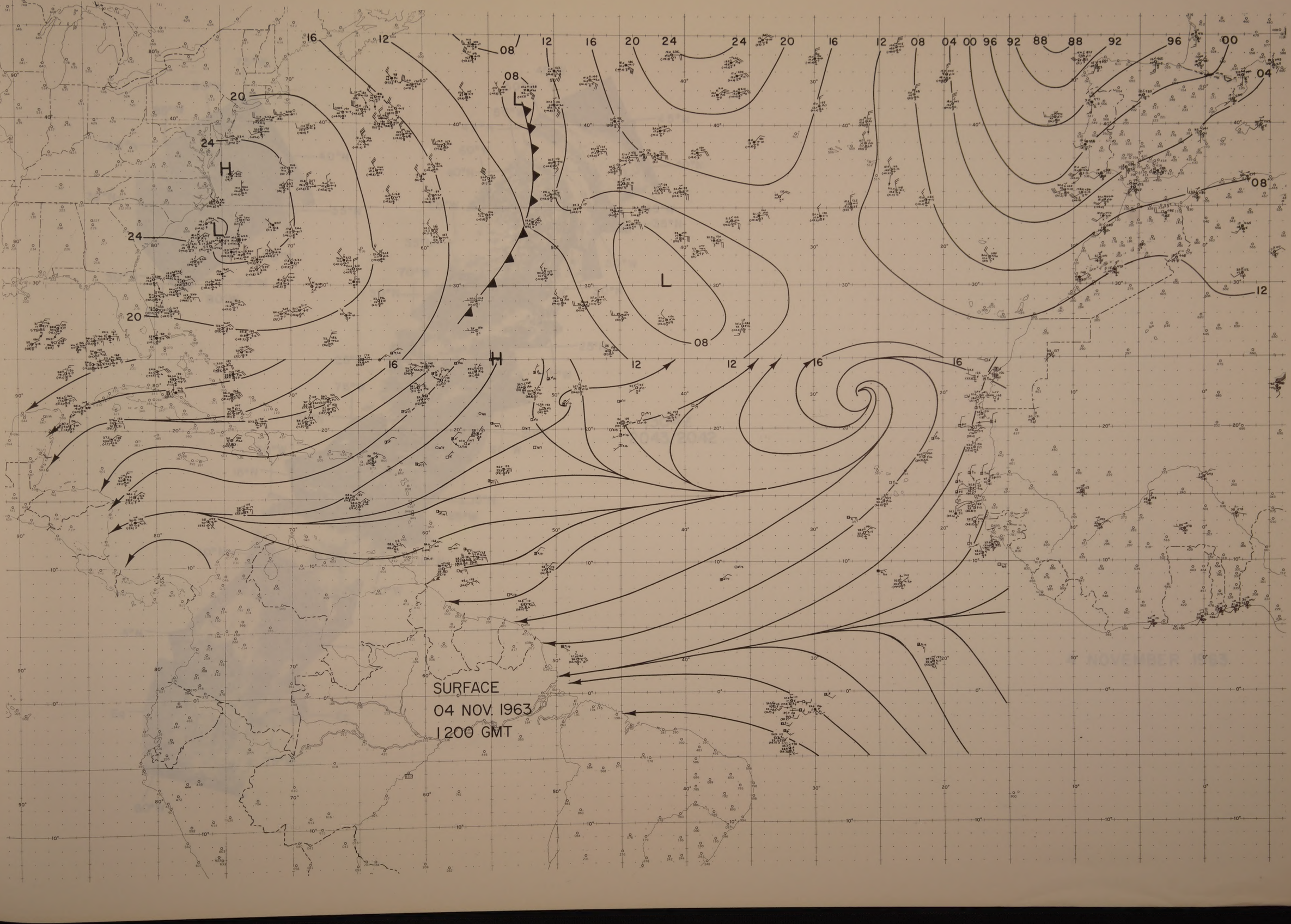
SURFACE
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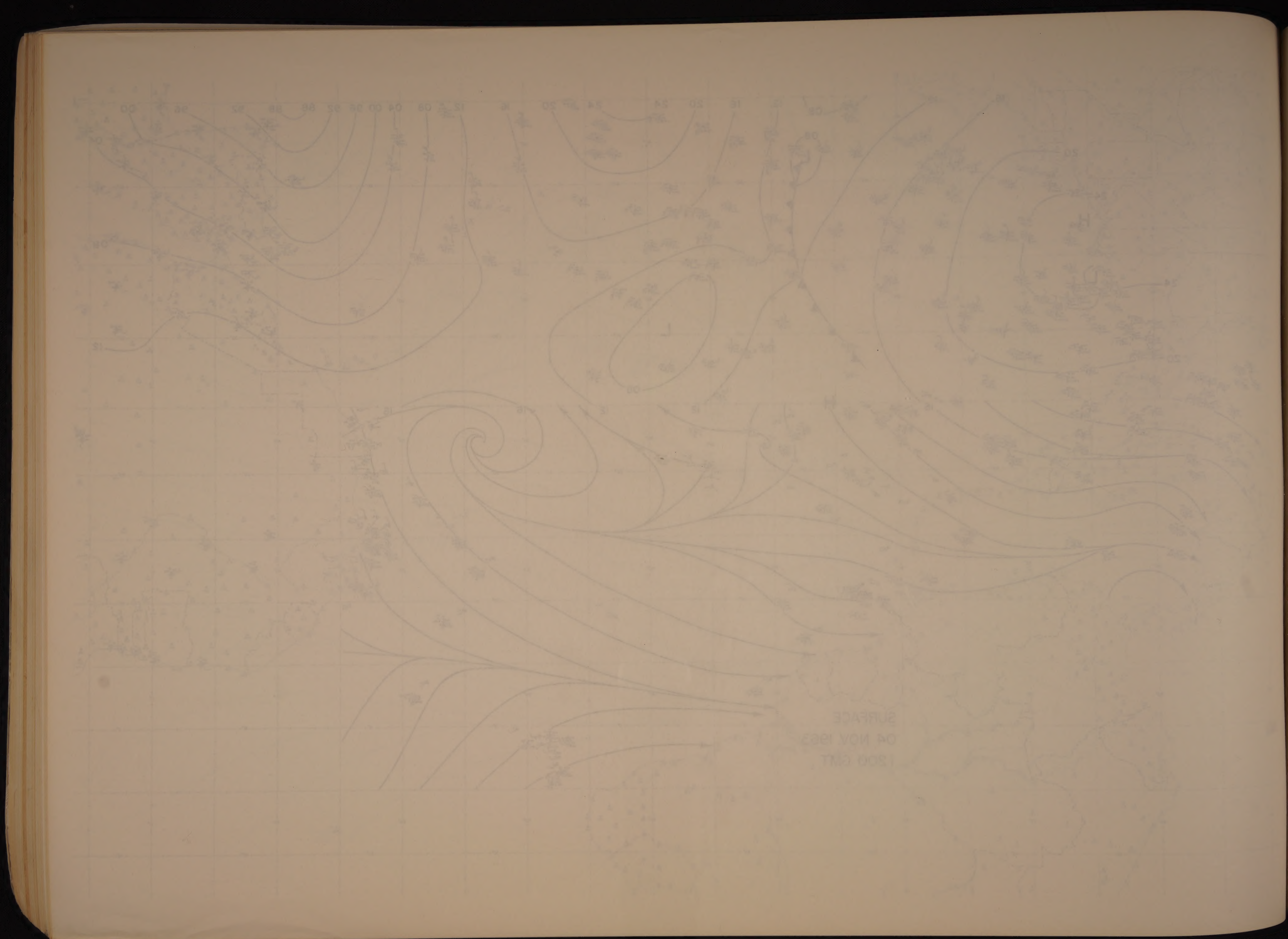
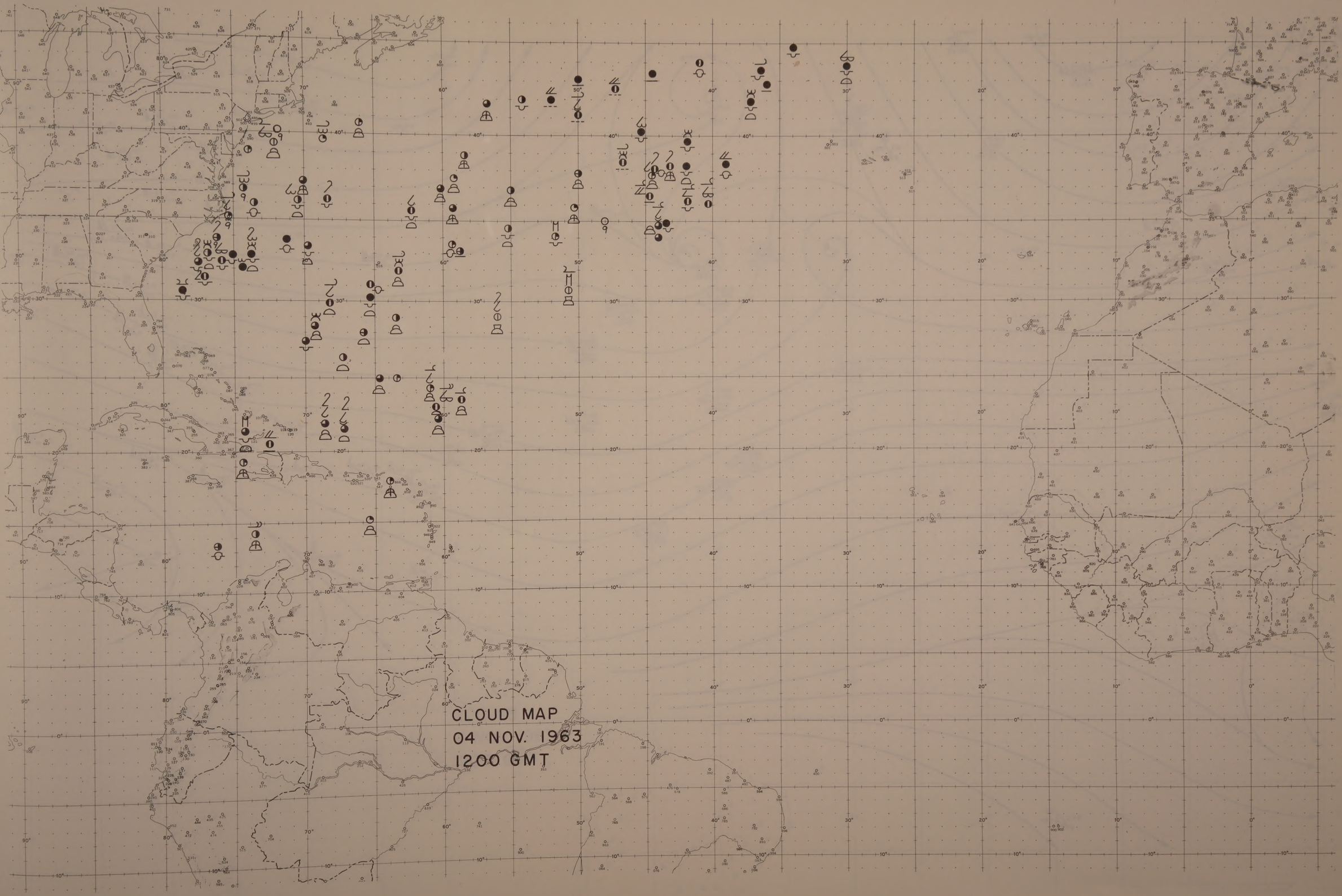
1200 GMT



1304Z
2043/2042

4 NOVEMBER 1963


CLOUD MAP
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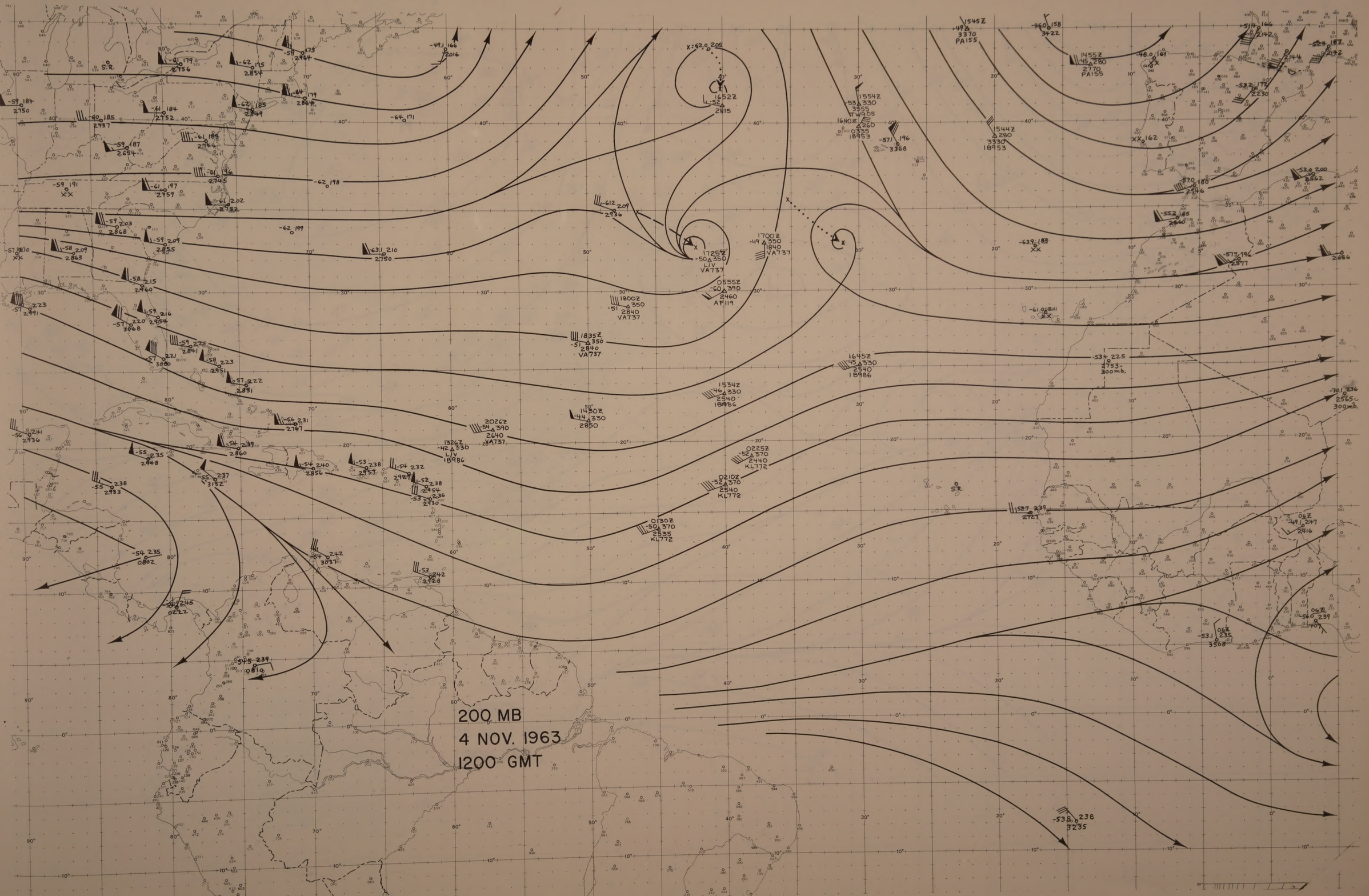
1200 GMT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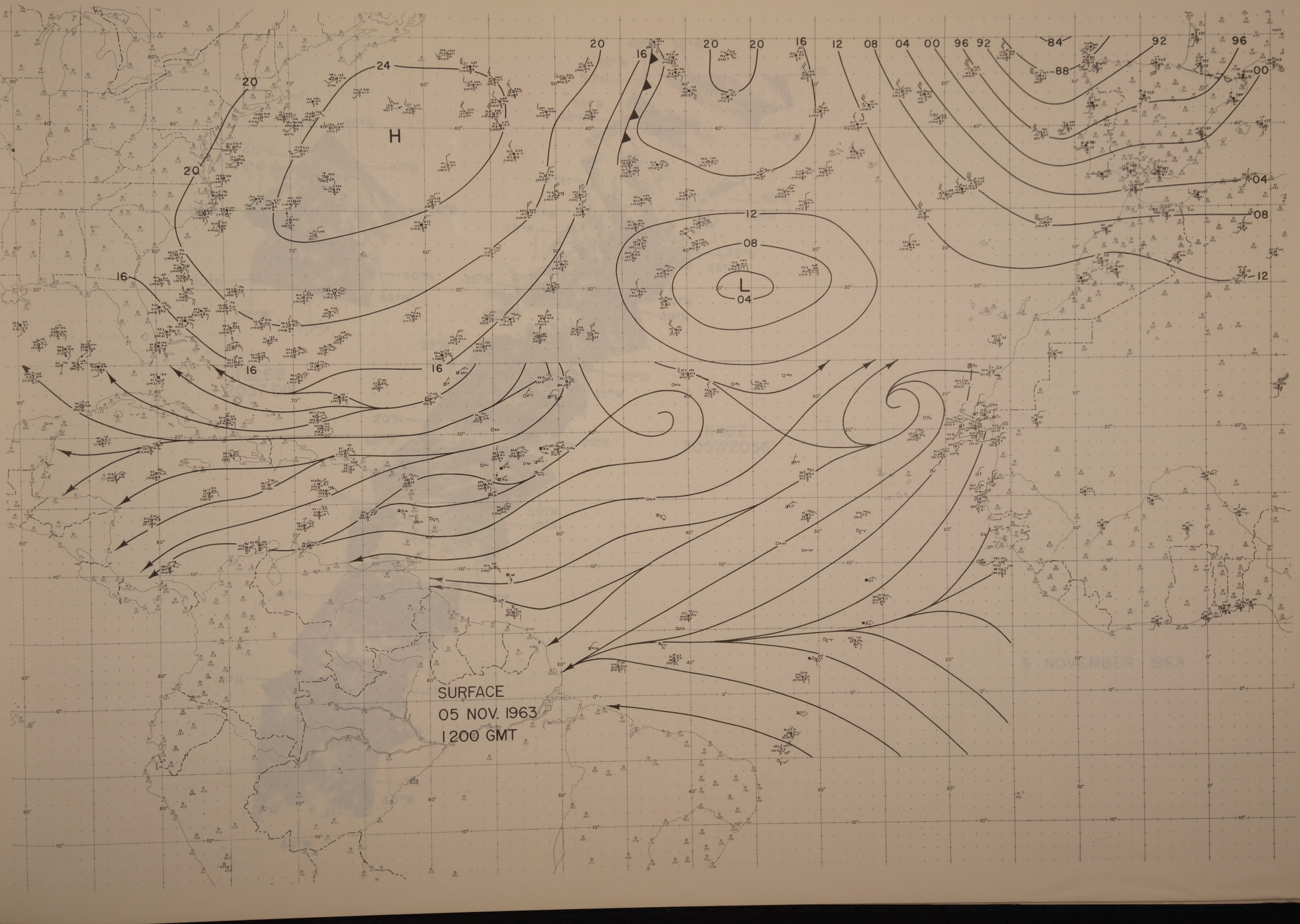
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SURFACE
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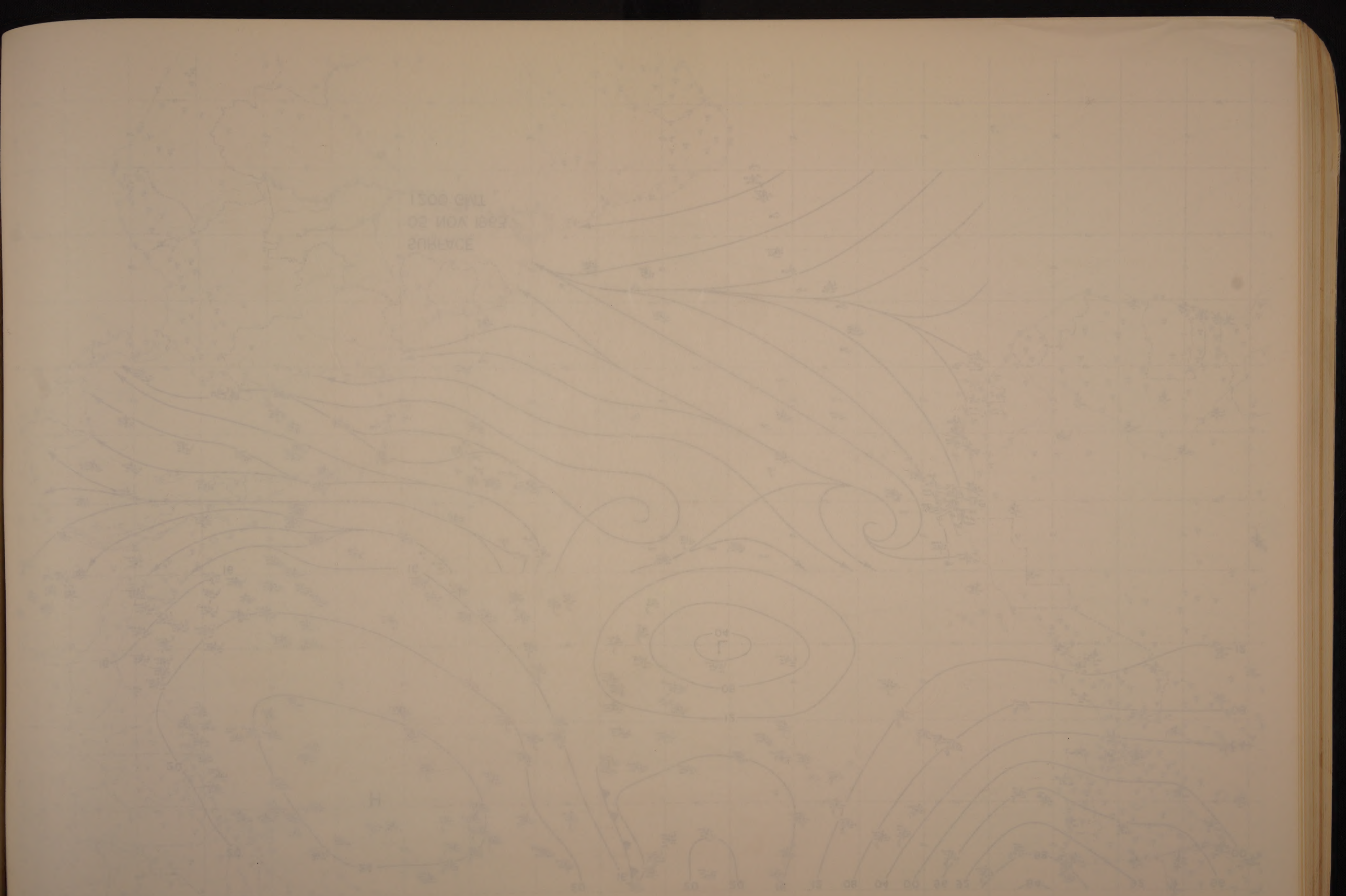
1200 GMT



1326Z
2057 DIR

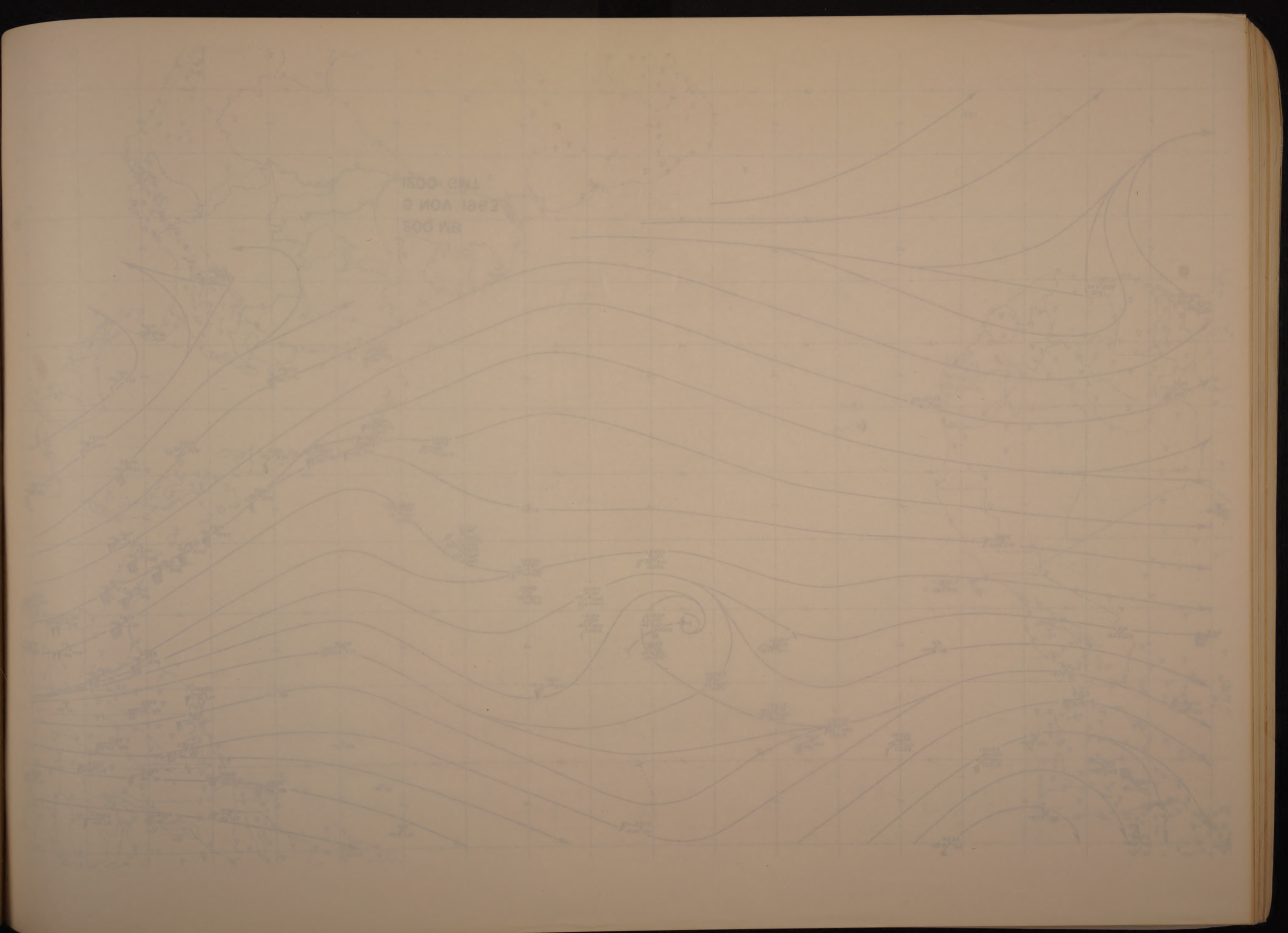
1149Z
2057/2056

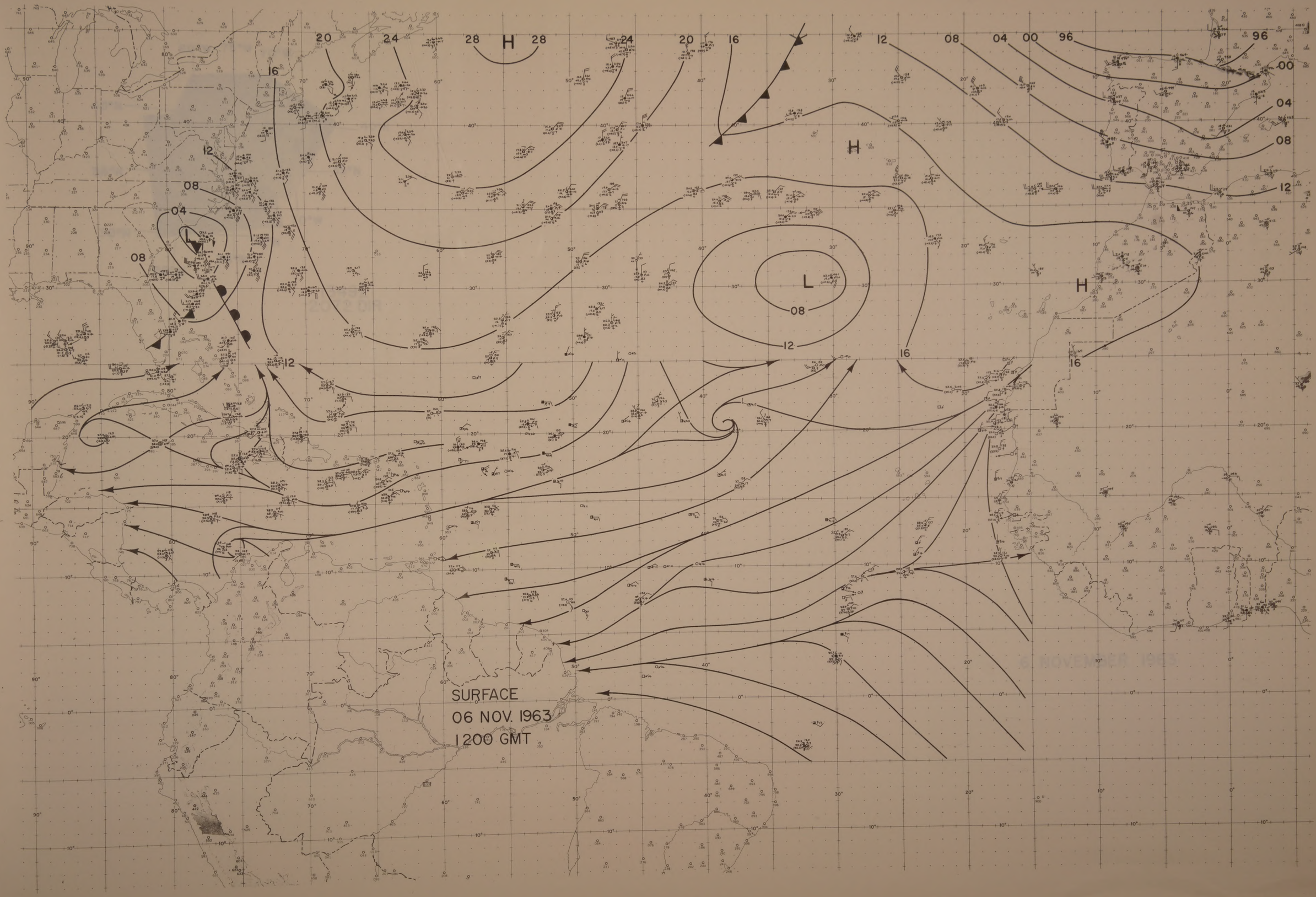
5 NOVEMBER 1963

CLOUD MAP
05 NOV. 1963
1200 GMT

CLOUD MAP
05 NOV 1985
1200 GMT

200 MB
5 NOV. 1963
1200 GMT

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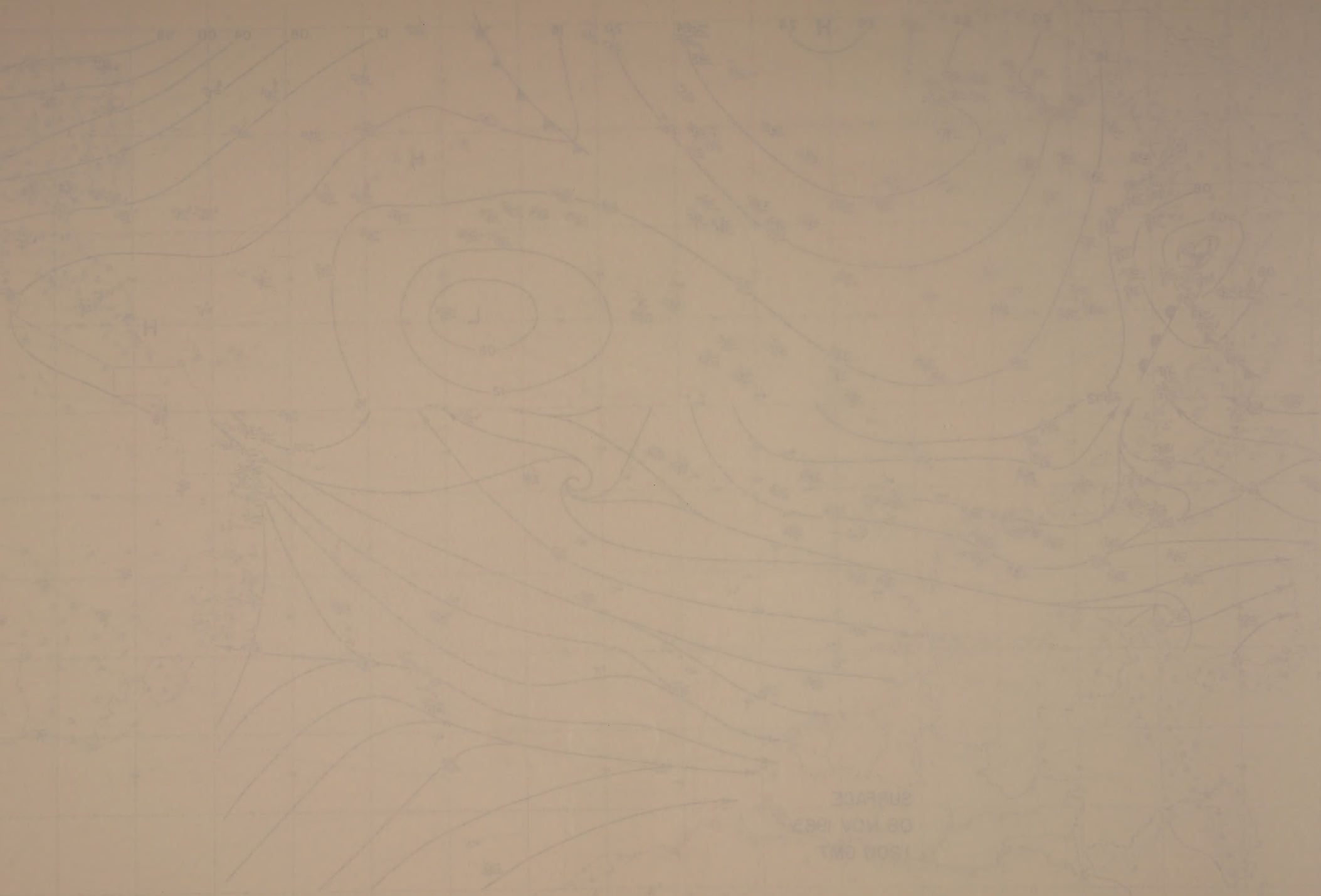
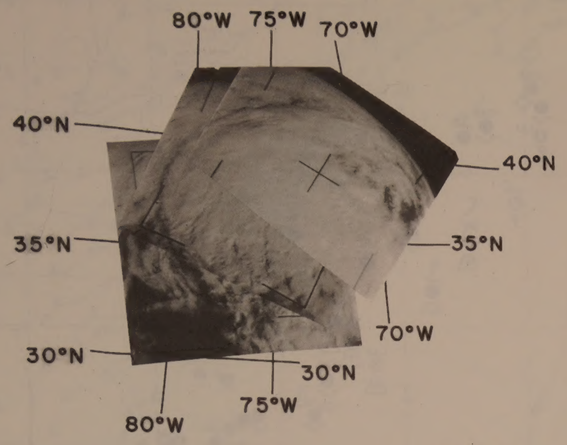
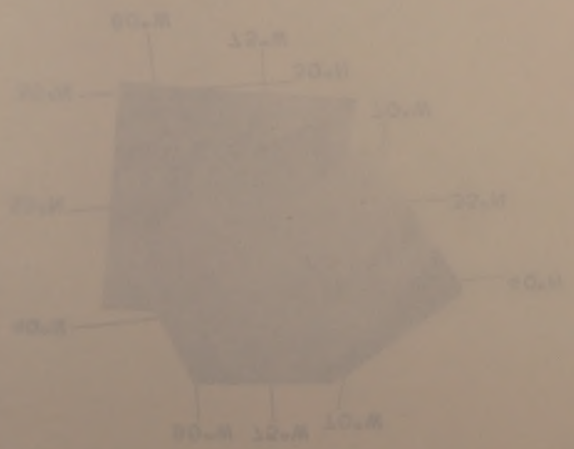
SURFACE
06 NOV. 1963
1200 GMT



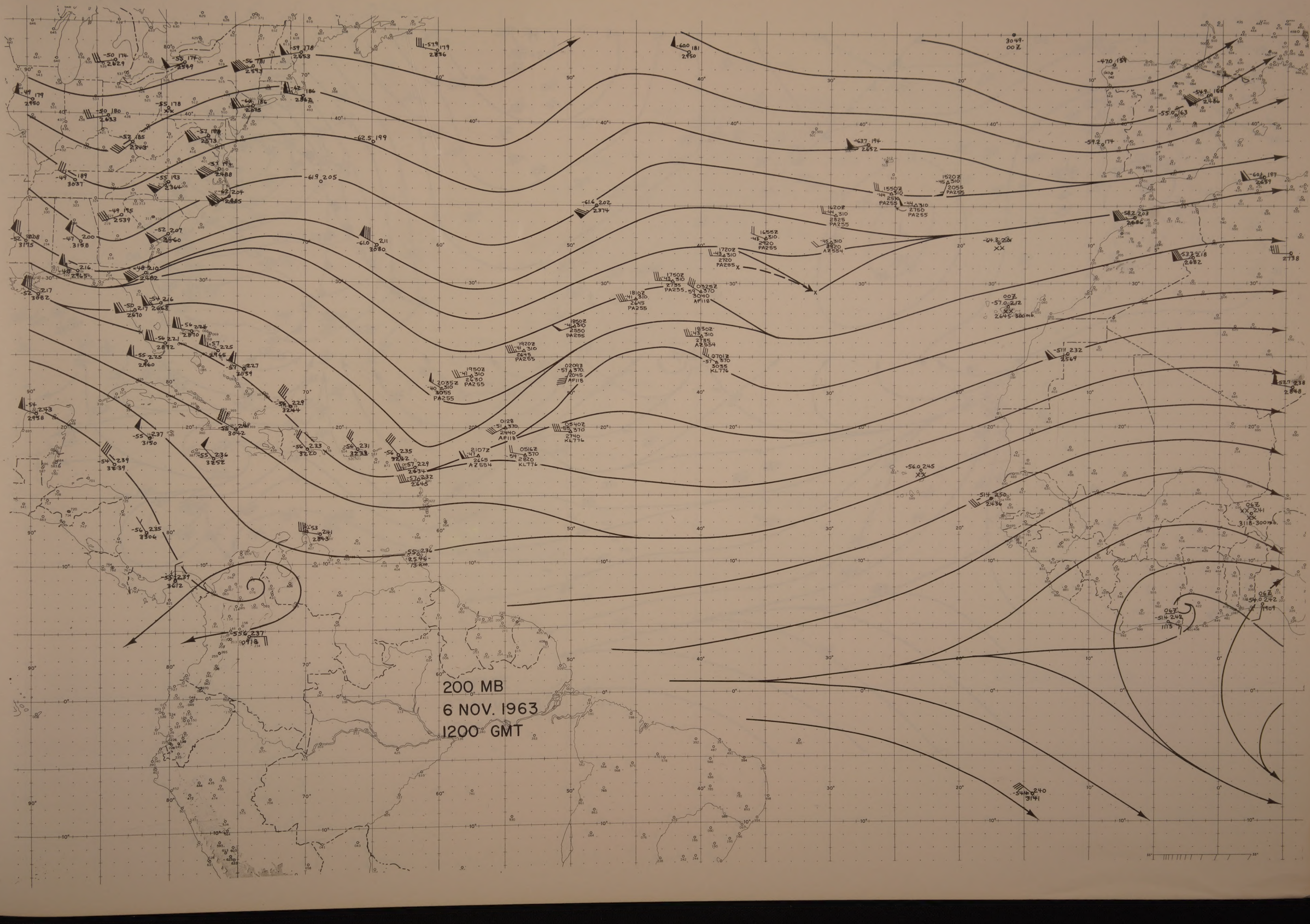


1349Z
2072 DIR

6 NOVEMBER 1963



CLOUD MAP
06 NOV. 1963
1200 GMT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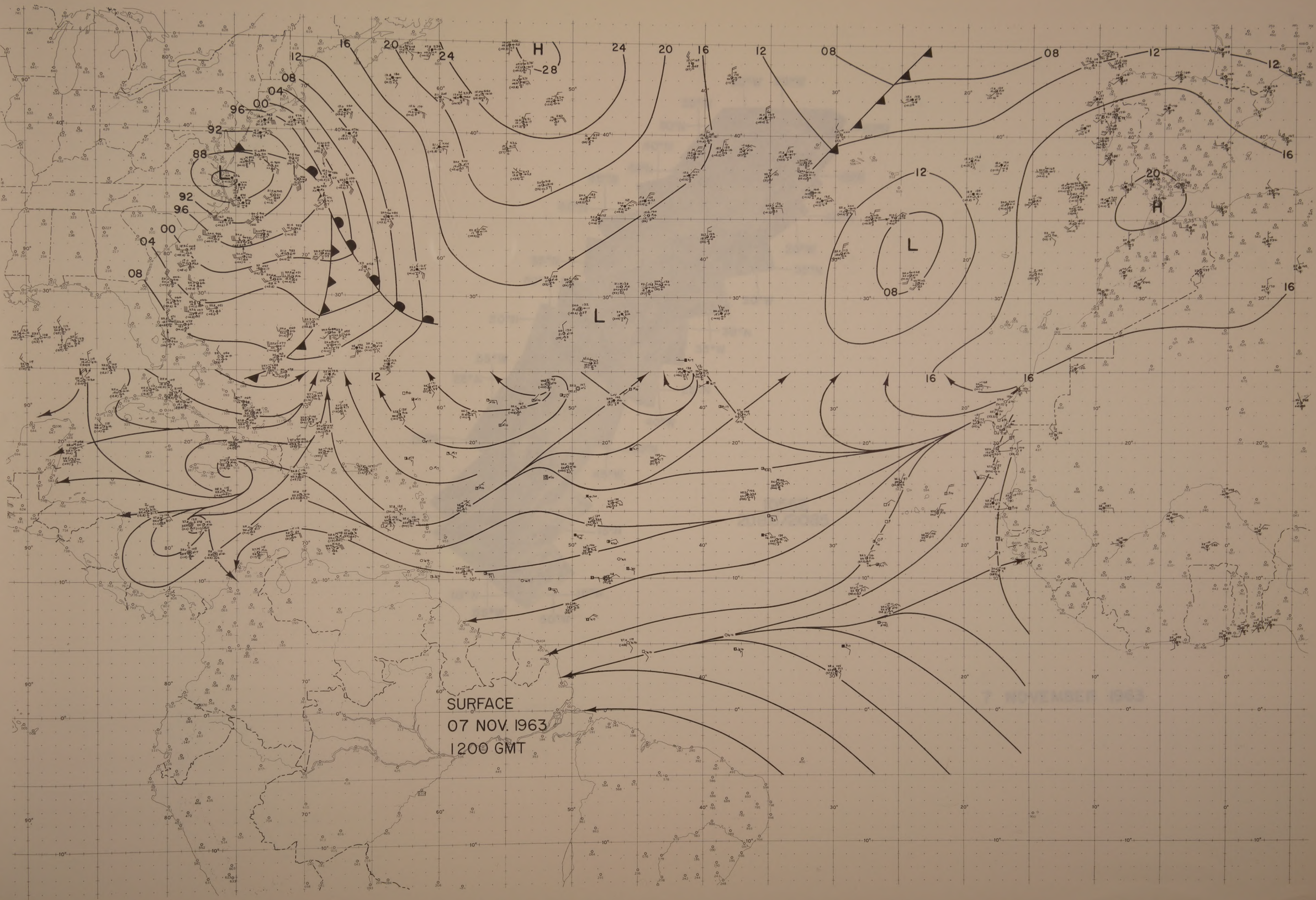
SURFACE
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1200 GMT

1055Z
2086/2085

7 NOVEMBER 1963

CLOUD MAP
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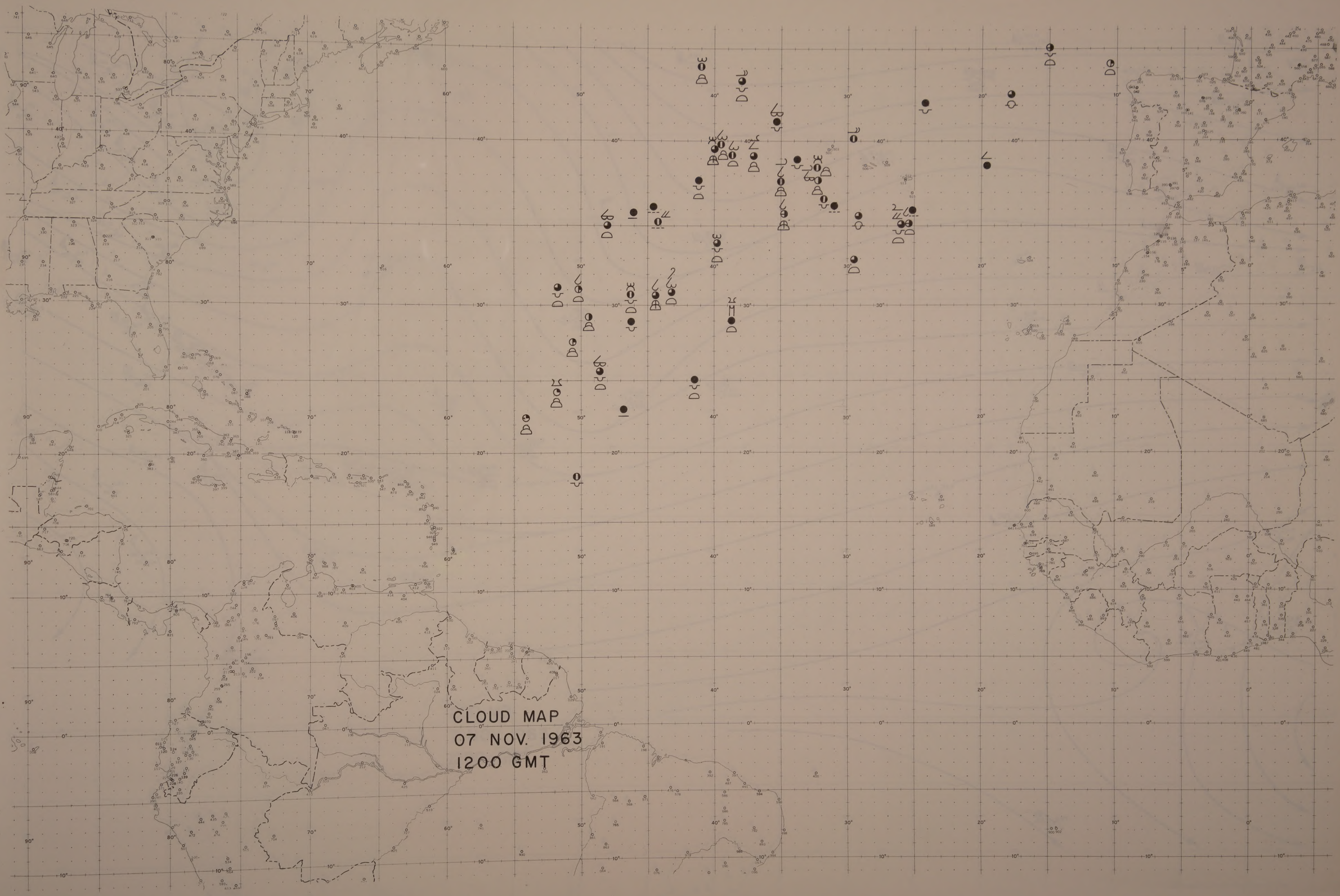
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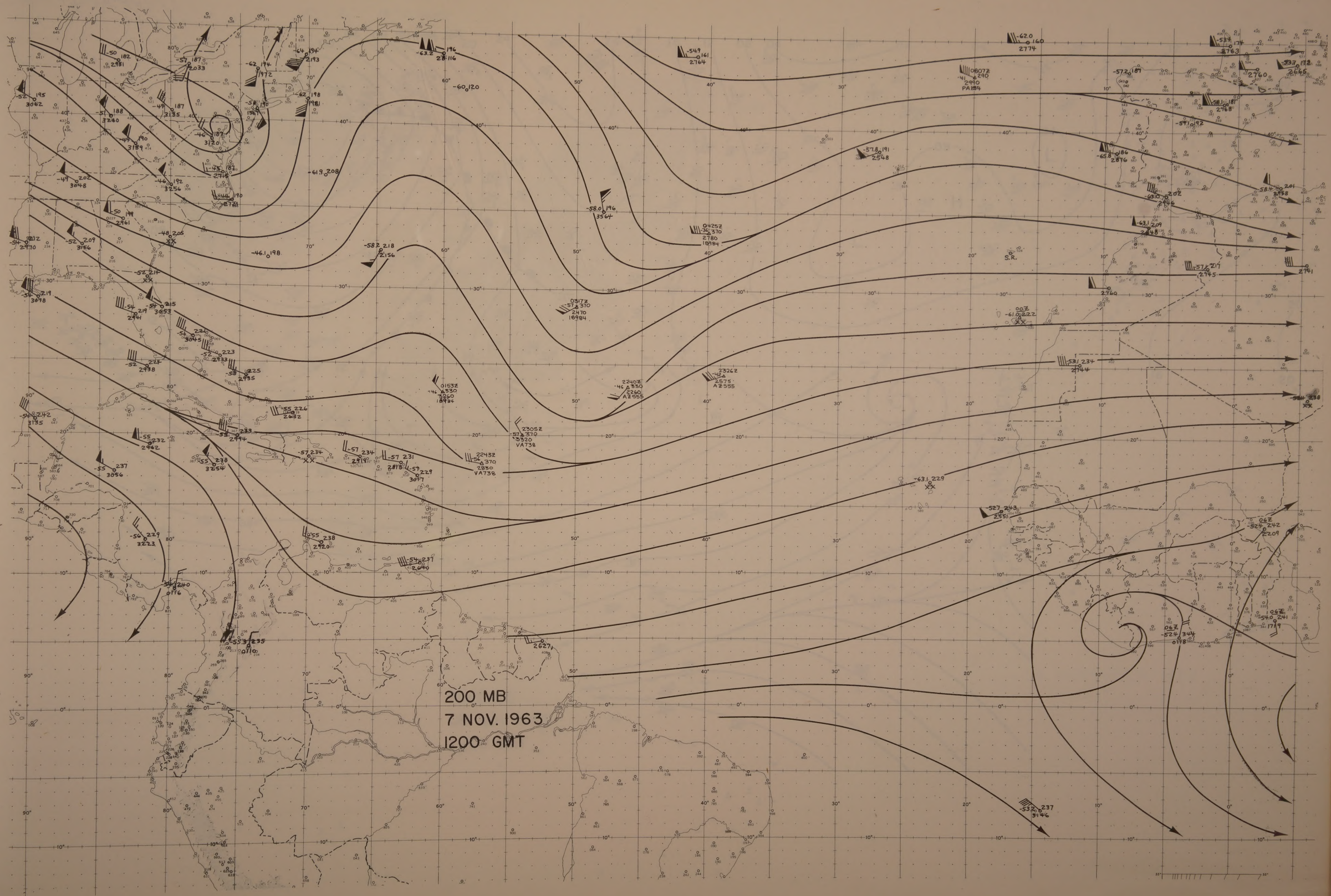
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SURFACE
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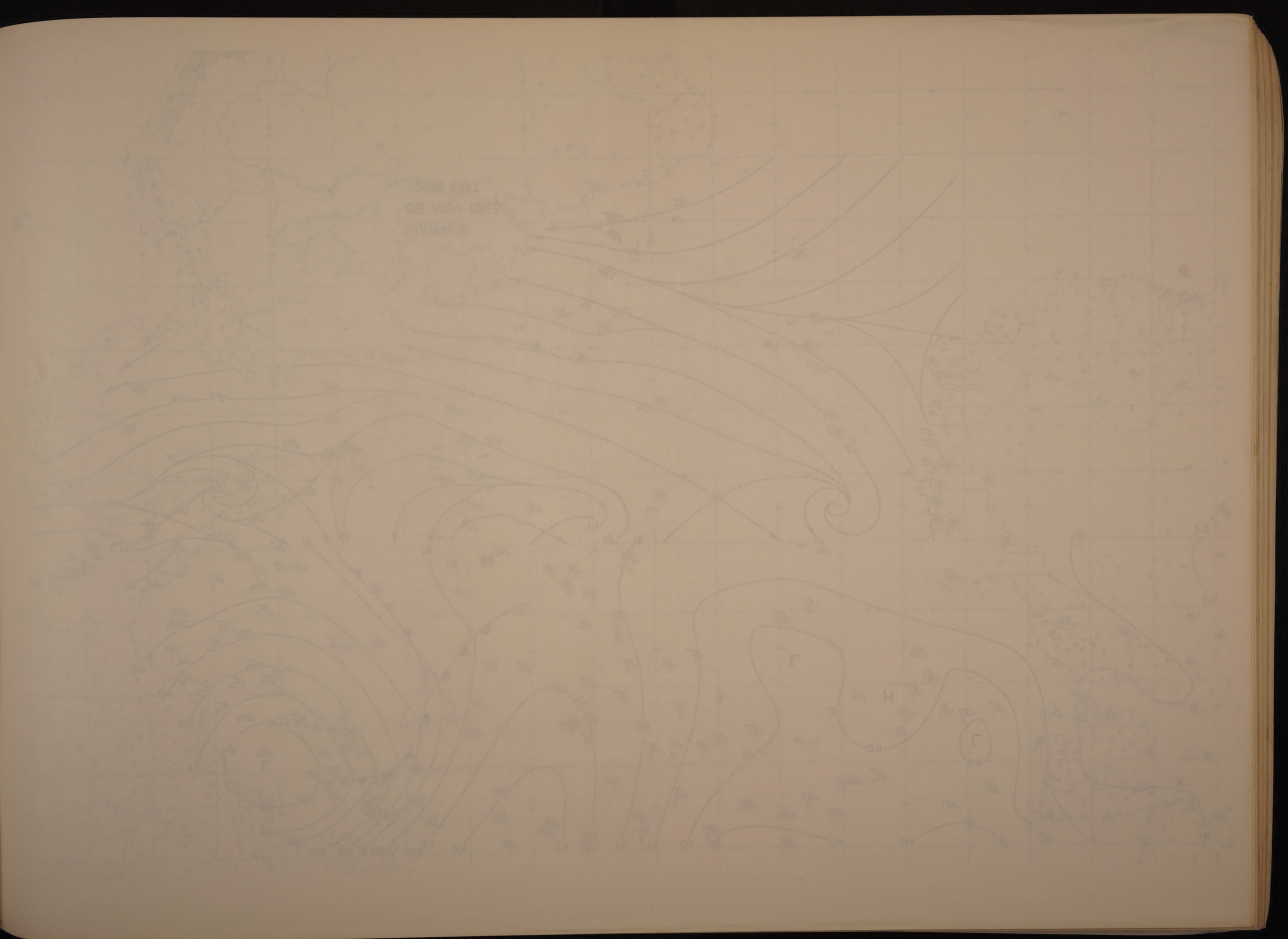

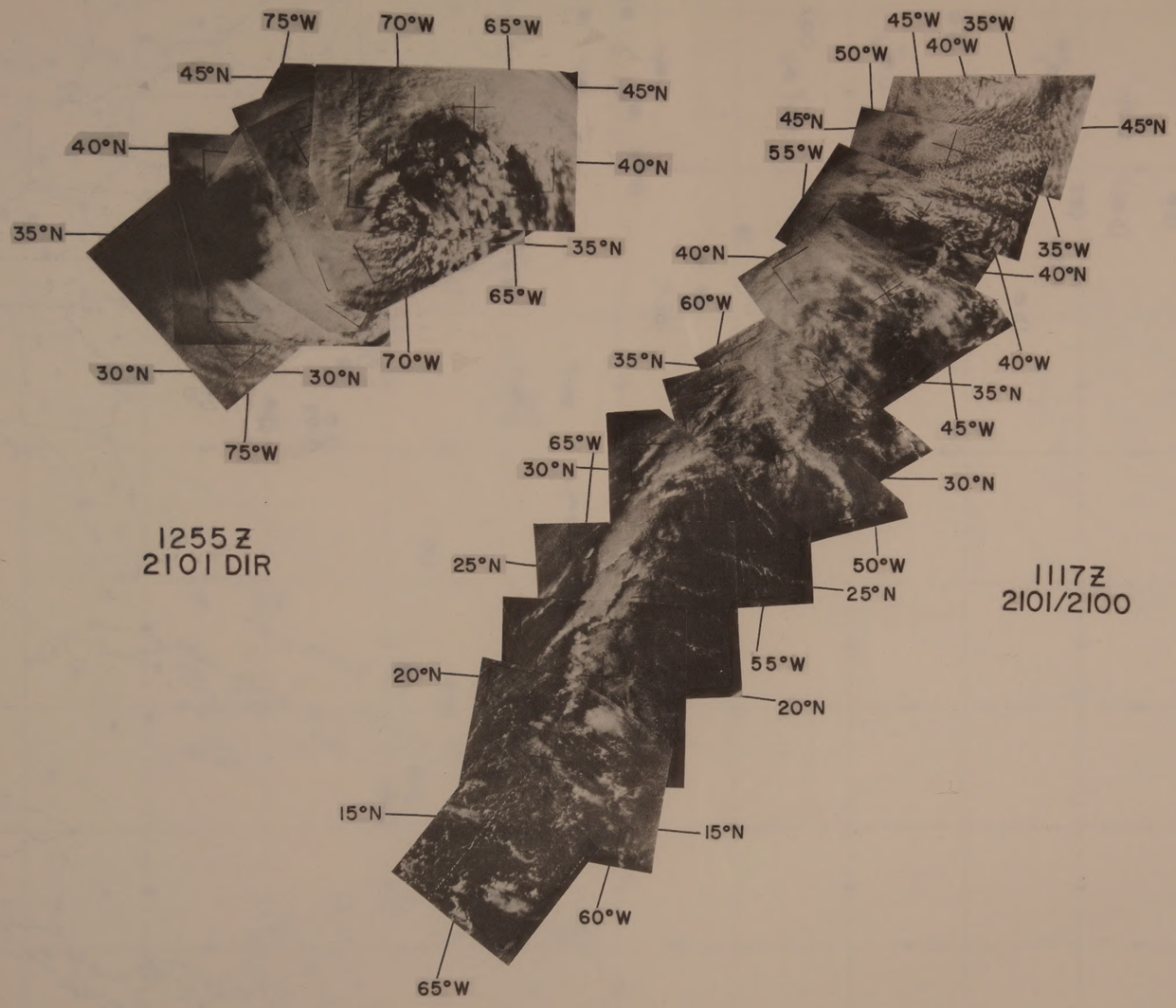

8 NOVEMBER 1963

CLOUD MAP
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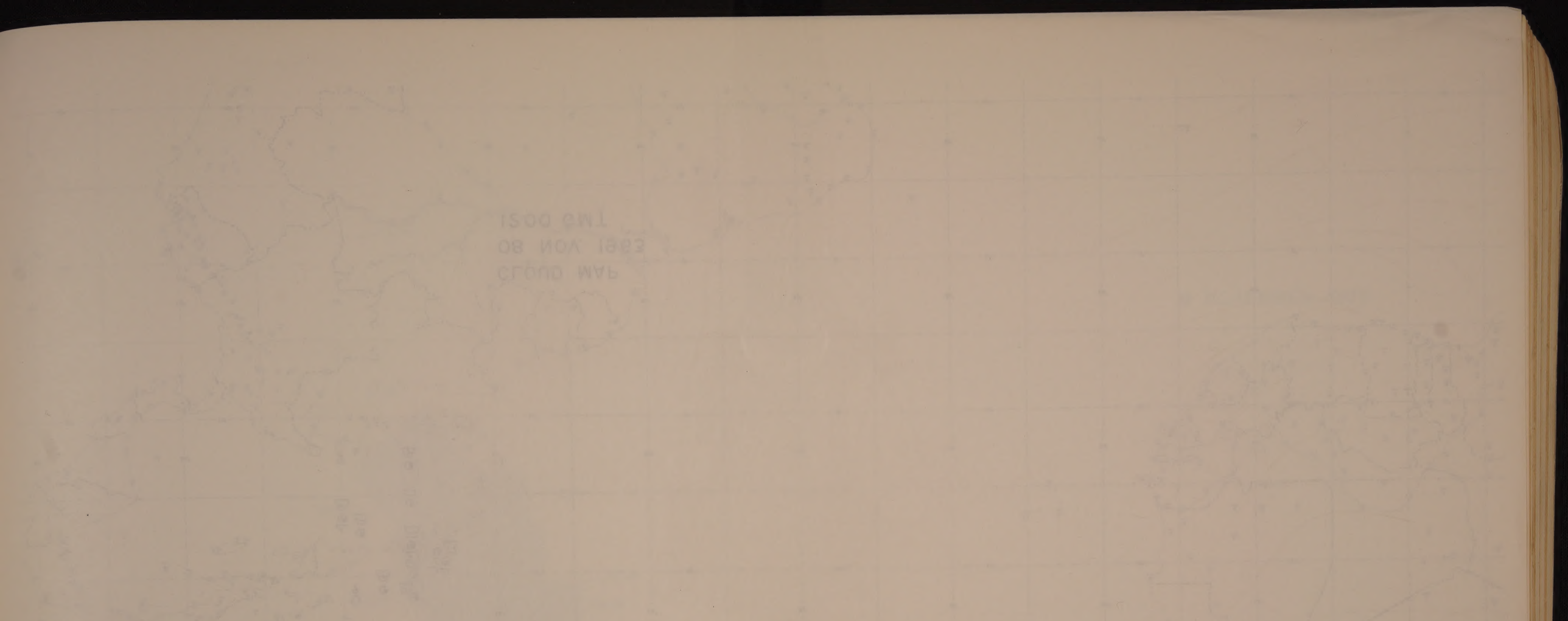

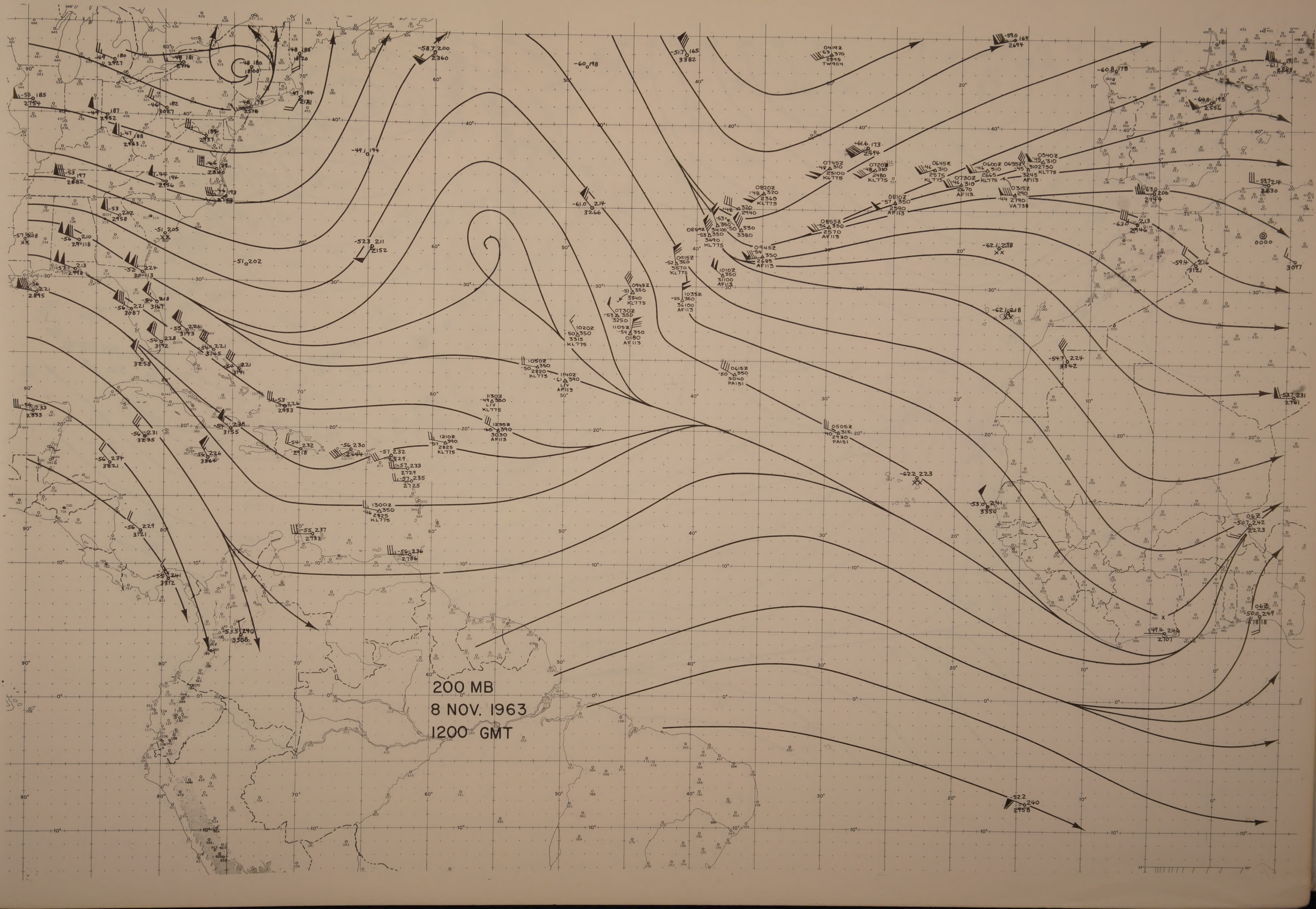
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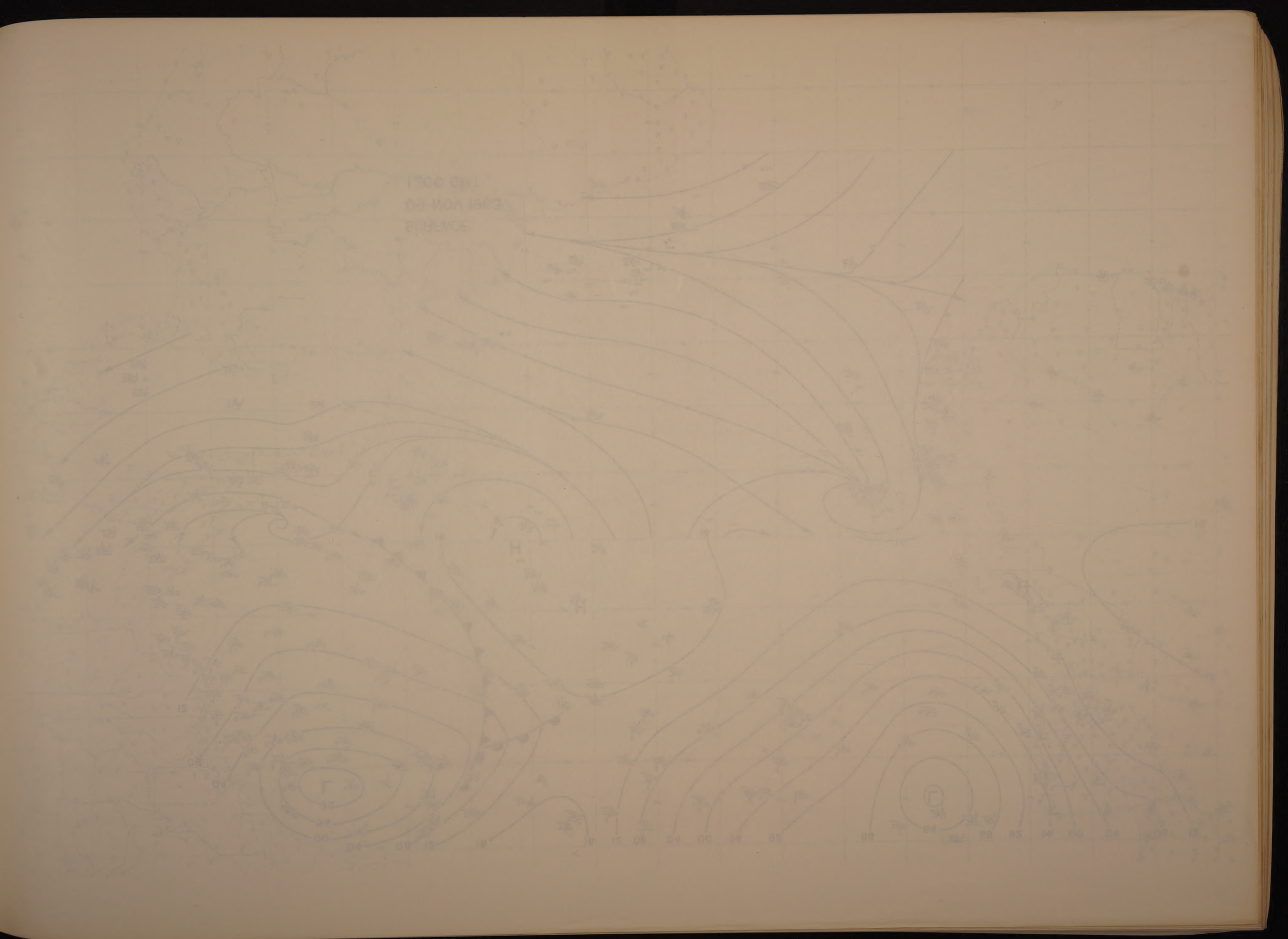

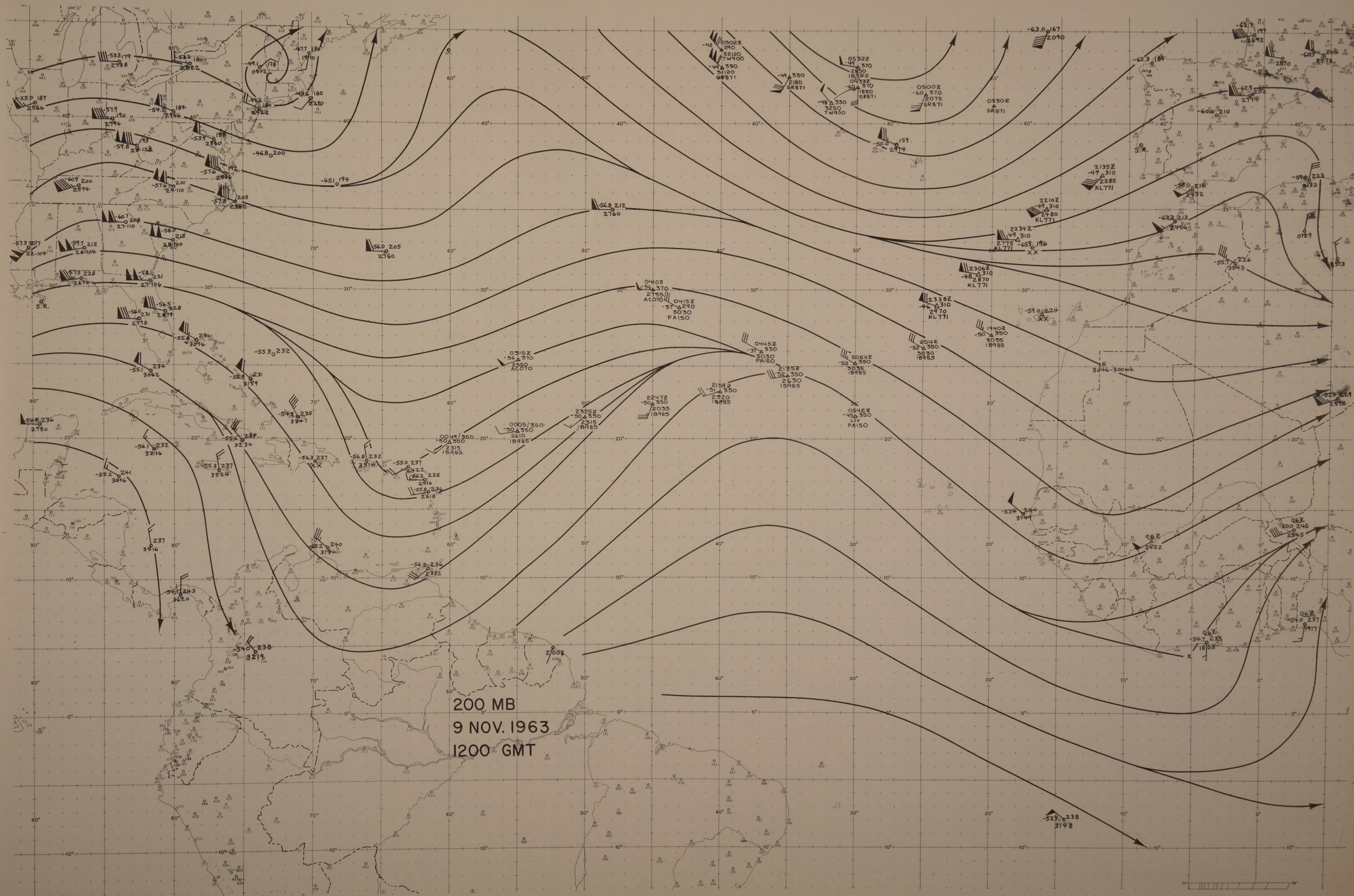
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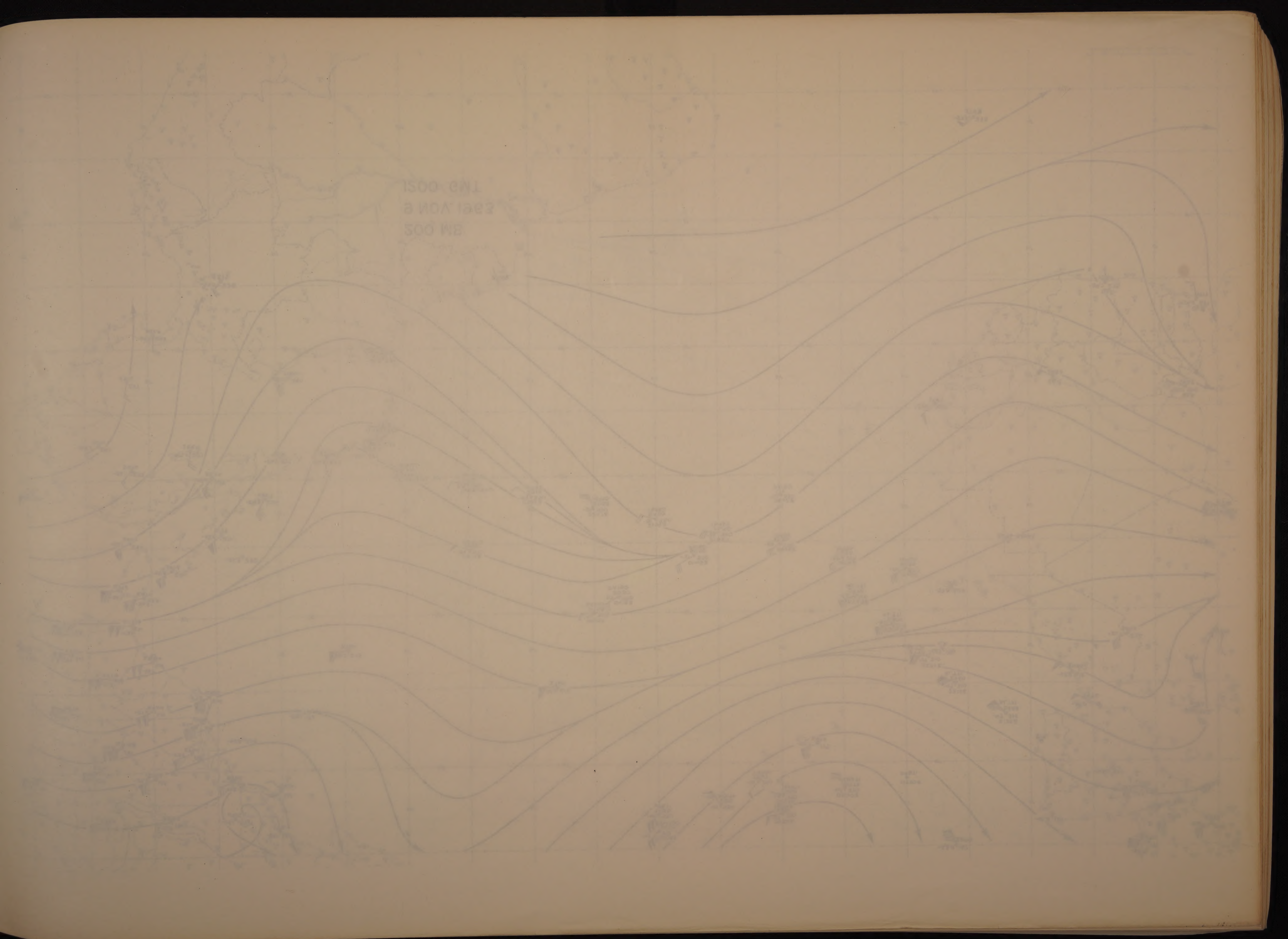

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